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REPORT

ON

INDUSTRIAL TOWNSHIPS

COMMITTEE ON PLAN PROJECTS
(BUILDINGS PROJECTS TEAM)
NEW DELHI

MAY 1963

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INTRODUCTION

0.1. Experience during the First and Second Five Year Plans has shown that 'Construction Works' accounted for nearly half of the total outlay of the Plan. Of this, a sizeable portion was spent on the construction of factories, residential buildings and provision of community facilities and amenities. During the Second Five Year Plan, the expenditure incurred on various types of residential buildings alone amounted to Rs. 250 crores. This figure is likely to go up to about Rs. 450 crores during the Third Plan Period.

0.2. Considering the magnitude of expenditure on residential construction, the Committee on Plan Projects set up a high level Panel to study the problem in detail and lay down "Norms and Standards" for various categories of residential buildings to serve as a guide for future planning. The report of the Panel on this subject was published in 1961.

0.3. This report mainly deals with the design of residential buildings, scales of accommodation to be provided for various income groups, and *inter alia,* certain suggestions for efficient space planning, provision of amenities, rationalization of specifications etc. A brief chapter on 'Planning and Lay-out' has been included in the report but necessarily this aspect could not be considered in sufficient detail, as the report was intended to deal mainly with residential buildings.

0.4. Residences form only one aspect of the 'Town Plan'. There are other important elements in it such as roads, streets, town centre, hospitals, parks and recreation places, schools, shopping centres etc. These elements have been planned and provided for in different ways in the townships recently developed by the various Industrial Undertakings resulting in a wide variation in capital costs.

0.5. As excessive capital outlay on township has an adverse effect on the cost of production, the Ministry of Steel and Heavy Industries and the Planning Commission felt that a detailed study of the existing townships be made with a view to evolving norms and standards for the planning of future townships and expansion of the existing ones.

0.6. At their suggestion, the Committee on Plan Projects in March 1962 set up a Panel under the Chairmanship of Shri N. V. Modak to study the problem. The composition of the Panel is given below :—

Shri N. V. Modak, Consulting Public Health Engineer, Bombay.	*Chairman*
Shri G. S. Ganapathy, Retired Chief Engineer, Mysore.	*Member*
Shri P.P. Dani, Officer on Special Duty, Hindustan Steel, Ranchi.	*Member*
Shri H. Rahman, Senior Architect, C.P.W.D., New Delhi.	*Member*
Shri S. D. Pathak,* General Manager, Hindustan Housing Factory, New Delhi.	*Member*
Shri P.C. Khanna, Senior Town Planner, Government of Punjab, Chandigarh.	*Member*
Prof. D. V. R. Rao, Head of the Deptt. of Architecture and Town Planning, Indian Institute of Technology, Kharagpur.	*Member*
Shri T. S. Vedagiri, Member-Secretary, B. P. Team.	*Member-Secretary*

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0.7. The first meeting of the Panel was held in New Delhi on March 26, 1962. A detailed questionnaire was then prepared to collect information on various aspects of planning, construction and administration of new towns from a number of Industrial Undertakings such as Hindustan Steel, Indian

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*Shri M. M. Patel took over in November, 1962 in place of Shri S. D. Pathak transferred.

Telephone Industries, Heavy Electricals etc. The Panel visited several industrial areas in Mysore, Madras, Bombay, West Bengal, Bihar and Orissa and had discussions with the authorities concerned. The list of industries visited and the persons with whom discussions were held is given in *Appendix* I.

0.8. Our study of the various industrial towns revealed that the figures for proportional use of land were widely varying. It was noticed that in some cases even though a large area of land was acquired, it was not efficiently utilised. Due to extravagance in planning the authorities are now faced with shortage of land to meet their expansion needs and the problem of further acquisition of land is not only costly but also time consuming. There appeared to be a tendency on the part of some project authorities to acquire more land in the initial stages than was necessary in order to play safe, whereas, in certain other cases, project authorities had given away some portion of land acquired by them and were subsequently facing shortage of land to meet the needs of their expansion programmes.

0.9. The extent of community facilities and density standards varied from one industrial town to another. The sector density was found to vary from 2 to 12 dwelling units per acre. Expenditure incurred on construction of sector roads varied from Rs. 480 to as much as Rs. 780 per dwelling unit. Cost of water supply distribution within the township ranged from Rs. 335 to Rs. 490 per dwelling unit. Similar variations were found in the provision of other amenities such as hospitals, health centres, schools etc.

0.10. Even with regard to the administration of the township there did not appear to be any uniformity in procedure.

0.11. These point to the urgent need for evolving suitable norms and standards for planning of townships. Based on our detailed study of the existing townships and the discussions we had with the various authorities, we have come to certain conclusions as to the method of planning of industrial townships and the norms and standards that should be adhered to. These are set out in the following sections.

0.12. The first two sections deal with the broad aspects of the planning of industrial townships. The services and public utilities to be provided in such towns are discussed in the third section. The fourth deals with the administration of industrial towns while the last one sets forth certain ideas for achieving cost reduction in the planning and execution of such towns.

0.13. We are extremely thankful to the authorities of the various projects who readily supplied the necessary data and made arrangements for on-the-spot visits and discussions which were extremely useful in formulating our recommendations.

We are also thankful to Mr. L. R. Vagale, Professor of Planning, School of Planning and Architecture, New Delhi, Shri D. D. Basu, Industrial Planner, Town & Country Planning Organisation of the Union Ministry of Health and Shri B. Kambo, Architect & Town Planner, Hindustan Steel, for their collaboration and constructive suggestions.

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Minister for Food and Agriculture

New Delhi, May 6, 1963.

My dear Lal Bahadur,

I have great pleasure in forwarding herewith the report of the Buildings Projects Team on Industrial Townships. We undertook the study of this subject in March 1962 at the instance of the Ministry of Steel and Heavy Industries and the Planning Commission, who felt that cost incurred on construction of townships for various industries in the public sector was on the high side.

We set up a Panel to undertake the study under the Chairmanship of Shri N. V. Modak, a Member of the Team. We had on this Panel a retired Chief Engineer from Mysore, a senior officer of the Hindustan Steel, Town Planners and Architects. The Panel visited a number of industrial areas in the country and studied the details of townships put up for various industries. They also held discussions with the authorities concerned. The other Members of the Team were also associated with the work of the Panel.

Based on these studies and discussions, the Panel has come to certain conclusions regarding the planning and construction of townships, which are set out in the report. A major recommendation of the Panel is that a Regional Planning and Development Authority should be set up as soon as a decision to develop industries in a region is taken. This, I think, would lead to integrated planning of the region and will avoid haphazard development.

The Panel has also set out in detail the standard of facilities and services that are to be provided in industrial towns. A section has been added on the administration of these townships. We have also given considerable thought to the ways and means of achieving reduction in cost of these townships and have listed a number of suggestions in the last section of the report. The report also contains a check list giving the various factors that should be taken care of in the planning of industrial township and the norms set out for each. If the project authorities carefully compile this check list and submit it along with their project report, it should enable the authorities at different levels to effect the necessary scrutiny, take appropriate decisions and accord necessary sanctions.

In preparing this report, we have taken considerable material from our other reports, such as, those on residential buildings, school buildings, hospitals etc. We have tried to bring together at one place all data relevant to planning of industrial townships which, I think, would go a long way not only in effecting reduction on capital outlay on these projects but also in achieving certain measure of uniformity in the planning standards and provision of facilities and services.

I take this opportunity to thank the authorities of the public and private sectors for their co-operation in supplying information required and for the facilities they afforded for site studies and discussions.

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Yours sincerely,

S. K. PATIL

SHRI LAL BAHADUR SHASTRI,
Minister for Home Affairs &
Chairman, Committee on Plan Projects,
Government of India,
New Delhi.

COMPOSITION OF THE BUILDINGS PROJECTS TEAM

Leader

Shri S. K. Patil,
Minister for Food and Agriculture.

Members

Shri Sarup Singh, I. S.E. (Retd.)
Formerly Director, National Buildings Organisation.

Shri N. G. Dewan, I.S.E.,
Chief Engineer, Central Public Works Department.

Maj. Genl. Harkirat Singh,
Engineer-in-Chief, Army Head Quarters.

Shri N. V. Modak,
Consulting Public Health Engineer, Bombay.

Shri C. B. Patel, Director,
National Buildings Organisation (ex-officio).

Member Secretary

Shri T. S. Vedagiri, Superintending Engineer.

Deputy Secretary

Shri P. S. Krishnaswamy, Superintending Engineer.

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1. Need for a Comprehensive Plan of Development

1.1. **Location of Industries.**—Prior to the inception of the First Five Year Plan, development of industries in India was mostly through the private sector. There was, therefore, a tendency to locate these industries in and around existing big towns, principally due to the ready availability of services, labour and marketing facilities. In turn, this resulted in heavy concentration of industrial activity and the towns catering to these industries grew into what are called metropolitan areas.

With the entry of the Public Sector in the field, the policy of decentralization of industries for bringing about a balanced development of regions and dispersal of population is being followed. This has mitigated, to a certain extent, the excessive concentration of industries and industrial population which usually gives rise to problems of transportation, public services, housing, creation of slums and social tensions etc.

The location of an industry is governed by a number of considerations, such as, availability of raw material, labour, power, transport, marketing facilities, climate, water supply and other services, and facilities for waste disposal. Subject to these factors and within the framework of a national plan for balanced development of regions, the final decision on the geographic location of major industries would lie with the Government of India.

On arriving at a decision as to the location of an industry in a particular region, efforts should be made to site the smaller among these industries in the vicinity of small and medium towns. This will, in the initial stages of the project, help to draw upon the resident labour from the town and also avail of the existing services and amenities. It will on the one hand avoid the raising of small single-industry towns which will be organisationally and economically not viable and on the other hand have the advantage of strengthening the economic base of small and medium towns.

In the case of heavy industries or a complex of industries requiring the housing of a large population, integration of the site with existing towns may be difficult, as it will impose a heavy strain on the utility services and community facilities available which in many cases are already deficient. Even the augmentation of these may not be feasible or economical. It may, therefore, be preferable to site such industries away from towns so as to give greater freedom to plan for their multifarious and complex requirements and at the same time give impetus to the economic development of the surrounding area.

1.2. **Need for a Comprehensive Regional Plan.**—It cannot be denied that the establishment of a major industry has an inevitable impact on the pattern of growth of surrounding areas. In many cases, we have seen that this particular aspect has not been properly taken into account resulting thereby in haphazard development all round.

For example, in Durgapur, where initially a steel plant was located, a number of ancillary and subsidiary industries have sprung up in an unco-ordinated manner, each with its own township, resulting in a conglomeration of several enclaves. These enclaves being separated from one another have created certain basic physical planning problems.

In Rourkela, a belt of land between the steel plant and the township was left unacquired with the result that this area has developed in a haphazard manner creating slums and unhealthy environment. Such instances also exist in some of the other industrial towns recently built.

Similarly, due to lack of forethought on the expansion **needs** of the main industry and those of the potential industries, unco-ordinated development has taken place at other places. This in certain cases, has stifled the expansion programme of the main industry itself.

Such situations can be avoided only when a regional plan for developing the region is prepared in advance. We therefore strongly recommend that the preparation of a comprehensive regional plan for the development of the 'influence' region in an integrated manner should be taken up as soon as the preliminary decision to develop an industrial complex in a particular region is made.

1.3. **Broad Contents of the Regional Plan.**—The regional plan should take into account probable industrial development in the region for the foreseeable future, *i.e.*, the next twenty years, the consequent urbanisation and the requirements of transport and communications, water supply, power etc.

The preparation of such a plan should be based on a number of physical as well as socio-economic studies and industrial potential surveys.

The plan among other things should indicate regional land use pattern such as :

(a) the areas for various main and ancillary industries;
(b) residential areas to be developed;
(c) agricultural and other allied uses; and
(d) major transport and communication network.

The plan should also incorporate schemes for supply of power and water and disposal of surface water, sewage and industrial wastes. Within the framework of such a regional plan, the detailed planning for individual industries and their residential areas should be taken up by the appropriate authorities.

1.4. **Authority for Regional Planning and Development.**—For the preparation and implementation of the regional plan, a Regional Planning and Development Authority should be set up which should have the representation of the main industry, State and Central Governments, Railways and other interests concerning trade and commerce in the region.

The major functions of this Authority will be:

(a) to formulate the regional plan;

(b) to enforce the provisions of the regional plan;

(c) to progressively review and revise the plan;

(d) to acquire and allot land to various industries;

(e) to take steps for the implementation of work required for the development of the region such as the provision of a network of transport and communication system, power, drainage, sewerage and water supply;

(f) to prepare the master plans for township if they are common to more than one industry.

NOTES—(1) For functions (d) and (f) para: 1.10 may also be referred

(2) Where conditions warrant, the functions of land acquisition and development of common services may be entrusted to a separate body. But this body should work in close collaboration with the Regional Planning and Development Authority

For the actual preparation of the Plan, this Authority should have the services of a Planning Team which will have Town Planners, Engineers, Architects, Industrial Experts, Economists, Soil Experts and other allied disciplines. This Team should be a whole time technical body working under the Authority so as to provide it with continuous technical services for carrying out the functions listed above.

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1.5. **Enabling legislation for the constitution of Regional Planning Authorities.**—The preparation of a regional plan is but a step towards the ultimate objective of obtaining balanced development of the region. To be effective, such a regional plan should have legal sanction. We understand that the Union Ministry of Health is already taking action in guiding the State Governments on the enactment of suitable legislation on town and country planning. As control and development over areas surrounding industrial townships are of great importance to the satisfactory development of main industry, provisions should be incorporated in the above-mentioned legislation to ensure effective and adequate representation of the Government of India and of the main industry.

Even in respect of the existing industrial areas, it would be advisable to constitute Regional Planning Authorities to plan and direct the future course of development.

In view of the urgency of this problem, both with regard to the existing and the future industrial areas, we recommend that the Central and State Governments should enact the desired legislation without further delay.

1.6. **Legislation for Peripheral Control.**—When once the regional plan as envisaged above becomes a legal document, the Regional Planning Authority will have full control over all construction and development activities in the region. But, the preparation of the plan and the mechanics of legalising it normally take time. During this period, there is every possibility of unauthorised construction coming up in-between and around the residential and industrial areas which may ultimately lead to creation of a number of slum pockets. It is needless to say that this will vitiate the very concept and objectives of the regional plan. It is, therefore, necessary to have an interim legislation to protect the periphery of the areas under development.

We can here cite the examples of the Punjab New Capital (Periphery) Act, 1952, Madhya Pradesh (Periphery) Control Act, 1959 and the Durgapur (Development and Control of Building Operations) Act which empower the respective State Governments to control the building operations in the periphery. We recommend that the Governments, Central and State, should examine the provisions of these Acts and evolve a suitable legislation for the purpose.

1.7.1. **Factors governing the size of a township.**—In the preceding paragraphs, we have discussed the general aspects of location of industries, the necessity for having a comprehensive regional plan, its broad contents, the authority to prepare the plan and enforce its provisions, as well as the desired enabling legislation for constituting such an Authority. These are the major regional aspects of industrial development. In the following paragraphs, we shall consider the specific aspects of an industry, such as, factors governing the size of its township, the land required for the various ancillary and subsidiary industries and the agency that will acquire and develop the land.

1.7.2. *Extent of housing and other facilities available in neighbouring towns and villages.*—The size of a township depends upon the type of industry, possibility of its expansion in the future, working force employed therein, places from which they are drawn, availability of residential accommodation in the vicinity etc. Provision of housing and other amenities to the employees is a necessity but it should also be remembered that it directly adds to the overheads and this factor should not be lost sight of in deciding the extent of housing to be provided in a township. In view of this, we feel, that while determining the population to be provided for in a township, the extent and availability of housing and other facilities in the neighbouring towns and villages should be thoroughly investigated.

Some of the small and medium public sector industries such as the Indian Telephone Industries, Hindustan Aircrafts Ltd. etc. near Bangalore have planned to house a part of their employees in their township. They have taken full advantage of their proximity to a metropolitan city and have thus reduced initial capital outlay on housing and other services. In such cases, the industry should make adequate contribution to the local bodies for the services availed of.

1.7.3. *Development of villages from where labour is drawn.*—Where the labour is drawn from neighbouring villages, efforts should be made to retain the workers in villages by providing sanitary facilities and other amenities therein. The possibility of utilising the funds available for community development schemes, etc. towards the redevelopment of such villages which supply labour force to industries should also be explored. Further, the industry could also grant loans to their employees living in villages to improve their houses. This will have the two-fold effect of minimising the initial outlay on the industry and of preventing the migration of people from villages.

1.7.4. *Provision for supporting population.*—In addition to the employees of the industry, the township has also to accommodate the supporting population. This population may be as much as a third of the total population of the township. Provision for this must be made in deciding the size of the township. Lack of such provision has led to the creation of slums on the out-skirts of towns.

There is, however, no uniform practice in the matter of providing accommodation for the supporting population. For instance, at Jamshedpur, the Tata Iron & Steel Co. leases out sites to non-employees to enable them to build their own houses and shops. As far as officers of Central and State Governments are concerned the practice is to allot land to the respective Governments to build houses for their employees. In Rourkela, non-employees can build houses on sites allotted by the Hindustan Steel and occupy them for the first ten years or so by paying a nominal rent. Thereafter, they are required to pay economic rent. The ownership of the property (land and building), however, vests with the Hindustan Steel. Any of these methods or a combination of these can be adopted for housing the supporting population.

1.7.5. *Housing of subsidiary and ancillary industries.*—Account should also be taken of the residential accommodation that may be needed for the expansion of the main industry and the township and for the subsidiary and ancillary industries, if these are not capable of supporting separate townships of their own.

1.8. **Land requirements.**—Taking all these into account and the township density which we have suggested in section 2 of this report, it should be possible for the authorities to fix a limit to the size of the town and estimate the land required for it. The practice of acquiring more land than what is necessary should be discouraged. We would also emphasise that care should be taken not to acquire good agricultural land for industrial, residential or other uses, unless it is absolutely unavoidable.

1.9. **Steps to prevent speculation on land**—There is often a sizeable time lag between the initial decision to locate an industry in a particular area and the actual starting of the works. This results in speculation on land on a large scale. We therefore recommend that steps should be taken to notify the whole area under Section 4 of the Land Acquisition Act as soon as preliminary decision for industrial development of a particular region is taken. Care should, however, be taken to see that the time lag between such notification and actual acquisition is not unduly long.

1.10. **Land Acquisition and Development.**—Where a large sized industry is located, it is inevitable that a number of ancillary and subsidiary industries develop around it in the future. Housing of workers of these industries is an important problem which cannot be overlooked. Whether this should be integrated with the township of the main industry or not, depends upon the relative size of the main and the other industries. From the point of view of economy, it may be desirable to have a common township so that services could be planned economically. This obviously raises the problem of acquiring, in the first instance, all the land required not only for the housing of the employees of the main industry but also for the subsidiary and ancillary industries. It will neither be advisable nor practicable for the main industry to acquire all the land, as it will lead to locking up of a considerable amount of capital.

We have, therefore, recommended earlier under para 1.4 that the Regional Planning and Development Authority shall acquire, develop and allot land to the various industrial undertakings according to their needs on a no-profit no-loss basis. It is necessary to equip the Authority with sufficient funds for this purpose.

Such a co-ordinated approach to the problem of land acquisition and development will lead to sizeable economy in the cost of land development and lessen the burden on individual industries.

The preparation of the detailed master plans for various residential areas within the over-all frame work of the comprehensive regional plan will result in an integrated physical development of the region and appreciable reduction in capital outlay.

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2. Elements of a Town Plan

2.1. **Need for a Master Plan.**—When once the preliminaries, such as, the location of the industry, the extent of residential accommodation to be provided etc. are decided, the physical planning of the township itself can be taken up. The first step is to prepare a master plan for the whole town which should show the line of future development.

The main elements of a well thought out town plan are the total needs of the community such as the pattern of circulation, open spaces, work, business and residential areas, cultural, educational, health and amusement centres and other amenities. It is the proper inter-relationship of these elements that goes to make an efficient town plan which enables its citizens to enjoy a full measure of civic life.

2.2. **Technical Agency for the preparation of the Master Plan.**—The need of a town plan may appear to be simple and specific, but every plan has necessarily to be a projection into the future of practically all human needs, which constitute urban life. This work requires interpretation and application of relevant social and economic trends and potentialities. Town planning is thus not a mere work of civic design. It should be the joint effort of a town planning team consisting of town planners, architects, public health engineers, sociologists, economists etc. Such a team with adequate technical staff should be under the whole-time employment of the relevant authority, not only for the preparation of the plan, but also to provide continued technical advice in the implementation and effectuation of the plan.

Big industries, like Hindustan Steel, Heavy Engineering, Heavy Electricals etc., can well afford to have a full-fledged organisation of the type mentioned above. Smaller undertakings, which cannot afford to have such organisation, would be well advised to take the help of the Town Planning Department of the State Governments, the Town and Country Planning Organisation of the Union Ministry of Health or private consulting firms of Town Planners. Services of specialists, where necessary, should be availed of by the planning team or the planning department.

Even where the job of preparing the Master Plan for a town is entrusted to consultants, there must be effective co-ordination between the consultants and the project organisation to avoid disparities in the provision of facilities and services.

On many occasions it may become necessary to allocate sites for the construction of hostels, guest houses etc. even before the completion of the master plan. A well-trained town planner should be able to allocate suitable areas for them even at the initial stage, so that they may fit in ultimately in the master plan.

2.3. **Location of Township in relation to the factories.**—The location of a new township in relation to the factory is of great importance and needs careful consideration. In a steel plant or a fertilizer plant, for example, wind directions play a prominent role in the siting of the township. The town has to be so located that the obnoxious gases emanating from the factory and the smoke or gas released from coke oven shall not pollute the atmosphere of the township. At the same time, the township cannot be placed far away from the factory as it will create problems of transport and communications.

The practice in many industries is to locate the township entirely on one side of the factory. In Jamshedpur, the township of Tata Iron & Steel Works is spread on all the three sides of the factory. We feel that if conditions permit, it will be advantageous to locate the town around the factory rather than concentrate it on one side only. The factory itself should have a number of gates for easy access from surrounding residential areas.

In siting the township, advantage should be taken of natural features, such as, hillocks, rivers and water sources.

In the case of heavy industries like steel, it is desirable to have buffer area between the factory and the township for reasons of security as well as for ensuring fresh air and unpolluted atmosphere for the township. The buffer may be 1/3rd to 1/2 of a mile deep (0.54 to 0.81 km) while in the case of smaller plants, it can be considerably less depending upon the wind velocities.

2.4. **The Town Plan.**—As mentioned earlier, there are a number of elements which have to be judiciously blended to get an efficient town plan. In the following paragraphs, we are discussing in detail each of these major elements.

2.5. **Neighbourhood.**—A properly planned town should stimulate community life and feeling of belonging and pride among the inhabitants. This can be achieved by dividing the town into planning units small enough to create neighbourliness. The smallest unit of organisation of the community is a neighbourhood which, although forming a part of the greater whole, *i.e.* a sector is also able to function as a single entity. Such a neighbourhood is planned around a primary school and local convenience shops.

The population of a neighbourhood should be so restricted that a school going child does not have to walk more than 5 to 10 minutes to reach the primary school without crossing a main road, and the housewife has not to cover long distances for obtaining the daily necessities of life. This can be achieved by keeping its population between 3 to 4 thousand persons.

2.6. **Sector.**—A neighbourhood can only cater to a limited community. Children have to go to a secondary school and the plan should be such that they can reach the secondary school without the fear of being run over by a motor car. This establishes the need of a community larger than the neighbourhood and large enough to support a secondary school. Statistics indicate that two to three primary schools can effectively support one secondray school. It is, therefore, desirable to group two to three neighbourhoods and form a sector having the secondary school as the centre of activity. A multipurpose hall, both for educational and community needs, can also be located near or attached to the secondary school. Such a sector may have a population of nine to twelve thousand persons. The sector should also have amusement and entertainment facilities and places for cultural activities.

For some years to come, separate schools will have to be provided for boys and girls. It will be desirable to combine two sectors so as to accommodate two secondary schools. Such a group of two sectors will necessitate the provision of a bigger shopping centre with better shopping facilities, a large community park for adult recreation, places of worship, health centre etc. The population thereof may be of the order of eighteen to twenty thousand persons.

2.7. **Access standards.**—In the light of the above discussion, the following table recommending the minimum and maximum distances to be covered for gaining access to schools, recreation areas, parks, shops and various public buildings in a sector is presented :

TABLE 2·1

Access standards for community facilities within the neighbourhood and the sector

	Suggested walking distance
1. *Schools*	
Nursery	1/4 mile (0·40 K. M.)
Primary	1/4 to 3/8 mile (0·40 to 0·60 K. M.)
Secondary	1/3 to 1 mile (0·54 to 1·61 K. M.)
2. *Recreation*	
Tot lot	1/8 mile (0·20 K. M.)
Children Park	1/4 to 1/3 mile (0·40 to 0·54 K. M.)
Adults' Playground	1/2 to 1 mile (0·80 to 1·61 K. -M.)
Adults' Park	1/2 to 1 mile (0·80 to 1·61 K. M.)
3. *Groceries and local shopping*	1/4 to 1/2 mile (0·40 to 0·80 K. M.)
4. *Health Centre*	1/2 to 1 mile (0·80 to 1·61 K. M.)
5. *Post Office*	1/2 to 1 mile (0·80 to 1·61 K. M.)
6. *Institutional*	1 mile (1·61 K.M.)
7. *Service shopping*	1 mile (1·61 K. M.)

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2.8. Planning of residential buildings.

2.8.1. *Housing and density.*—In the planning of residential buildings, one of the most important considerations should be to obtain residential densities which result in efficient and economical use of land. Since, however, the word 'density' has got different meanings when used in different contexts its implications in this report are as follows :

(i) *Neighbourhood Density.*—This is defined as dwelling units*/ people per acre on the total residential plot areas including access roads, incidental open spaces, local parks, primary schools and convenience shops. It also includes half the width of the road around the residential block.

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*A residence occupied by a single household is considered as a dwelling unit for the purposes of this report.

(ii) *Sector Density.*—This is defined as dwelling units/people per acre over the total area covered by a sector (having at least one secondary and two primary schools) inclusive of all internal roads, streets, footpaths, residential unit, parks and open spaces within the neighbourhood, secondary, primary and nursery schools, police post, health centre, post and telegraph offices, group of shops with a sizeable community park and other community facilities provided within the sector. It also includes half the width of peripheral roads that serve the sector. In other words, it includes all lands within the sector, plus half the area of surrounding roads but excludes areas covered by all town level facilities such as hospitals, cinemas, police headquarters, central fire station, main post and telegraph office and central retail and commercial area, town centre, civic square, etc.

(iii) *Township Density.*—This is defined as dwelling units/people per acre for the total developable area of a town inclusive of all the areas covered by the town facilities such as town centre, central commercial areas, hospitals, work centres, town parks etc. It however, excludes all sizeable areas which are undevelopable but which may have to be acquired for certain geographical reasons, peripheral green belts and major reservations surrounding the town areas.

2.8.2. *Recommended densities.*—Until recently it has been the practice to prepare town plans with low densities and the same concept was adopted in the plans of the new industrial townships constructed during the last decade. This has resulted in spreading of the towns over a wide area and the consequent increase in the cost of services both in capital outlay and maintenance. It has also created the problem of transport. The recent tendency all over the world has been towards increasing the densities in towns to keep down the cost of services, as it is being recognized that the increase in densities is not in any way detrimental to the health and well being of the citizens, provided adequate open spaces are made available.

In view of this, we recommend the following figures of density for the planning of future townships and the expansion of the existing ones.

Sector density: 14 to 20 dwelling units per acre (65 to 95 persons per acre).

Township density: 9 to 12 dwelling units (45—55 persons per acre).

2.8.3. *Accent on intensive development.*—These densities can be easily achieved by adopting two to three storeyed construction depending upon climatic conditions. This will incidentally lead to compactness of the town in addition to achieving economy in the cost of services. Single storey construction can, however, be adopted in a restricted measure for the housing of high income group. This will enable the town planner to achieve a variety of architectural composition.

Even in the case of the expansion of existing industrial towns, the authorities concerned should make serious efforts to increase the density so as to come as close as possible to the figures mentioned above without sacrificing minimum living and health standards.

2.8.4. *Scales of accommodation for residential buildings.*—Based on a techno-economic survey carried out by the Committee on Plan

Projects, the Government of India has laid down scales of accommodation of housing in industrial projects. A copy of the Government of India memorandum on this subject is given in *Appendix II.*

2.8.5. *Plot Areas.*—We also noticed that plot areas in individual quarters were rather on the high side probably because land was cheap at the time of initial acquisition. It is seldom realised, that when the township grows up, the value of the land automatically appreciates and further acquisition of land for expansion programmes is difficult. It could, therefore, be advisable to conserve the land by adopting higher figures of plot coverage.

Experience has demonstrated that plots with depths varying from 1½ to 2 times the width facing the road are more desirable, as this type of layout provides frontage for a larger number of plots for a given length of road.

Taking the above into consideration, we recommend that the plot areas to be provided for the various categories of dwelling units should be as per table given below :—

TABLE 2.2

Plinth and plot areas for various housing categories

Type	Category	Income group	Plinth area		Plot area per ground floor unit	
		Rs. p. m.	Sft.	Sq. Meters	Sq. yds.	Sq. metres
I	F	Below Rs. 60/-	365 Sft.	33·87	100-150	83—125
II	E	60—150	400 „	37·12	150—200	125—167
III	D	151—300	600 „	55·68	200—250	167—209
IV	C	301—750	900 „	83·52	325—400	271—334
V	B	751—1500	1500 „	139·20	650—850	543—711
VI	A	Above 1500	2100 „	194·88	850—1000	711—836
			Plus 240 sft. for servants and 225 sft. for garage.	Plus 24 sq. meter for servants 21 sq. meters for garage.	Plus 100 Sq. yds. for servants & garage.	Plus 83 Sq. meters for servants & garage.

NOTES—

1. The above plot areas shall apply to dwellings of 2 to 3 storey construction. For multi-storeyed dwellings exceeding this number of storeys and apartment houses, adjustments in plot areas will be necessary.
2. A few tall buildings eight to ten storeys high should be provided to serve as bachelor apartments and for providing accommodation for visiting experts.
3. It is advisable to build different types of dwellings such as detached, semi-detached, row houses, etc. with different number of floors to achieve a good architectural composition as well as variety.
4. The income groups indicated above are under revision, in view of the revised scales of pay.
5. In special cases the plot areas for type VI may be slightly increased.

2.8.6. *Design for residential buildings.*—It was observed that for a given plinth area there were a number of designs with varying degree of liveability. While some were good, many were unsatisfactory in a number of ways.

As this subject was studied in detail by the Panel on Residential Buildings of the Committee on Plan Projects, we are summarising in the following paras some of their observations and recommendations.

In some cases, adequate attention had not been given in fixing the location of doors and windows in the rooms to ensure efficient circulation. In others, the room itself served as a passage impairing its utility.

In many designs, little importance was attached to the use to which the room was to be put. The shape of any room has to suit the function for which it is intended to be used and the placing of furniture has also a bearing on its shape. Proper location of doors and windows in a room ensures its maximum utility. It is, therefore, imperative that serious thought is given to the exact placement of furniture in the room in relation to doors and windows at the planning stage itself.

Based on the study of the analysis of space utilization of dwelling units already constructed in various projects, it is considered that it should be possible to produce well balanced dwelling units, if the allocation of spaces for the various elements of the plan are made to conform to the percentages given in the following table:—

TABLE 2.3

Design efficiency standards for residential buildings

	Load bearing construction	Framed construction
	Per Cent	Per Cent
(a) Living space *i.e.* floor areas of living, dining and bed rooms	47—50	49—54
(b) Service space covered by kitchen, bath, W. C., etc.	15—20	14—19
(c) Horizontal circulation space-passage and verandahs	10—12	9—11
(d) Vertical circulation space-staircases and lifts	4— 7	3— 6
(e) Walls and columns space	15—17	12—14

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It will be a good practice, if the authorities in charge of designing of residential buildings indicate on the plan the analysis of the built up area into the different categories mentioned above. Any variation from the limits suggested should be justified. This will ensure proper space utilization, which is considered the most important factor contributing to economy and efficiency.

The ratio of the living space to the plinth area is a good index of planning efficiency. Endeavour should, therefore, be made to obtain as high a ratio of living space as possible, by reducing to the minimum the circulation space and the area occupied by the walls.

At the instance of the Committee on Plan Projects, the Central Building Research Institute, Roorkee, have prepared type layout for the various categories of industrial housing. These may be of use to the authorities in charge of planning industrial townships.

2.8.7. *Orientation.*—The subject of planning of dwelling will not be complete without a few remarks on the important aspect of orientation.

In most of the Industrial Townships visited by us standard designs had been prepared for the different categories of housing. These are, however, being laid out in the same stereotyped manner without reference to proper orientation. As orientation of buildings has naturally to vary depending upon local conditions on each site, we suggest that two or three alternative designs for each category of housing should be prepared and the one most suitable for the particular location adopted.

The subject of orientation itself is very important and has to be properly understood by Town Planners, Architects and Engineers, charged with the task of designing, laying out and constructing buildings.

This has been dealt with in the report on residential buildings referred to above.

2.8.8. *Socially Balanced sector.*—With a view to evolving a socially balanced and integrated community, it is desirable to skilfully group together dwellings meant for different income-groups. Such an integrated development will avoid the status barriers and give a social cohesion to the sector.

2.9. Circulation pattern

2.9.1. *Circulation pattern.*—In the past, roads in a town were mainly used by pedestrians. These functioned as the centre of daily life of its citizens where life rolled on in a leisurely manner. The advent of automobile has changed the functions of the road. Roads and streets now mainly cater for vehicular traffic of varying speeds and thus circulation pattern has assumed greater importance in the town plan.

In view of this, it has become necessary to segregate the pedestrian and vehicular movement. This calls for an entirely new conception of the road pattern in the new town. A system of pedestrian ways has to be created linking various residential areas with one another and with the work centres and other areas to ensure the safety of the pedestrian from the danger of being run over by the automobiles. This should be advantageous both to the pedestrians and the vehicular traffic. Such a road pattern will enable the automobiles to reach their destination quicker and the pedestrian walks running through the green ways will provide safe and enjoyable walk for the citizens to reach their destinations. While deciding on the road pattern, the needs of not only the present day traffic but also of the traffic likely to be encountered 20 years hence will have to be taken into account.

2.9.2. *Express cycle tracks.*—To a pedestrian or a cyclist moving along a main traffic route with all its discipline and restrictions against him, the main road cannot only be inconvenient and unsafe but also irritating. Therefore, it will be preferable to have a network of cycle tracks and pedestrian ways cutting through the open spaces and providing shorter routes from the residential areas to the factory. Such a network of cycle tracks and footpaths fitted in a proper landscape can be a source of great enjoyment and recreation.

2.9.3. *Avoidance of level crossings.*—The planning of the road system in the town should be so done as to avoid crossing of railways branch lines. Where this is not possible, the crossing should be so arranged that the level crossing in the initial stages can be replaced at a later date by a system of grade separation.

2.9.4. *Service lanes.*—Provision of service lanes is a matter which requires individual consideration for each town. No service lanes have been provided in the township visited by us except in Jamshedpur. We were told by the authorities that no serious difficulty had been encountered by them in having access to sewer lines etc. In the absence of such service lanes. Provision of service lanes adds to the cost and such lanes are rarely kept clean. We strongly advocate that provision of service lanes should be dispensed with, except in the case of row housing where they may be necessary for convenience and accessibility.

2.9.5. *Norms for Road Widths.*—In the new towns visited by us, it was observed that the roads covered a large percentage of the town area due to the provision of excessive widths and defective circulation pattern. This results in heavy expenditure on construction and maintenance.

The actual width of the roads and streets and the number of traffic lanes should generally depend upon the volume of traffic during the peak-hour prevailing at present, the projected volume of peak hour traffic in the next 20 years and also the composition of traffic.

Based on this we recommend the road standards given in the table below :—

TABLE 2.4

Road and Street Standards

Type	Right of Way	No. of Lanes
Arterials with central median ..	200′ (61m) on the periphery of the town otherwise 160′ (49m)	One on either side of the central median to start with and two on either side ultimately.
Major Roads (Principal traffic routes)	80′ to 100′ (25 m to 30 m)	Two lanes to start with and four lanes ultimately.
Neighbourhood roads	45′ to 60′ (14m to 18m)	Two lanes

TABLE 2.4—*contd.*

Type	Right of Way	No. of lanes
Residential streets	30′ to 45′ (9m to 14m)	Two lanes
Culs-de-sac not to exceed 600′ in length.	25′ to 30′ (8m to 9m)	Two lanes
Loops giving access to residences (with open spaces on one side) ..	10′ to 15′ (3m to 5m)	
Service lanes (to be provided in the case of row housing only) ..	15′ to 20′ (5m to 6m)	
Cycle Tracks	7′ to 9′ (2m to 3m)	

NOTES : 1. Footpaths of adequate width should be provided on the arterial roads, major roads and some of the neighbourhood roads.

2. Cycle tracks may be provided along major roads, if necessary. The above widths provide for this.

3. All roads should be black topped or concreted except service lanes.

2.9.6. *Roads side arboriculture.*—Avenue trees should be planted on both sides simultaneously with the construction of roads, so that when roads and buildings are completed they get the benefit of shade. In cases where a single line of trees is to be planted, it should be on the South and West side.

Care, however, should be taken that no fruit bearing trees are planted along the road side since once these trees grow up and bear fruit, children run on roads and footpaths to collect the fruits which may result in accidents. Such trees may be planted in clusters in parks and organised open spaces. It is desirable to avail of the services of a landscape architect in planning roadside arboriculture, parks and playgrounds.

2.10. Community facilities

2.10.1. Housing and roads alone do not constitute all the requirements of a town. Various other facilities such as schools, colleges. parks, open spaces and sports grounds, shopping, health and cultural centres, have to be provided to enable the citizens to enjoy a full measure of community life. The extent and nature of these amenities are dealt with in the following paragraphs.

2.11. Educational facilities

2.11.1. *Primary and Secondary Schools.*—The ratio of children of school going age to the total population varies greatly from one community to another. Computations in new industrial communities, where relatively young married couples migrate show different figures from those for average urban areas with mixed economy. For planning purposes, it is important to establish a ratio, not based on the present trends but the future school age computations say 20 years hence. The finding of the Committee for reorganisation of education in India is "that the proportion of school going age children in the country as a whole will decrease at an accelerating rate in the next decade or so due to the stabilisation of population, family planning and other effective methods in population control".

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The following table indicates the number of school-going age children expected for each type of school per 1000 population :—

TABLE 2.5

School going age group projections

School	Age Group	Class	Projected Fig. for 1980 per 1000 population	Percentage for expected enrolment	Adjusted index/1000 population
Nursery	3—4 to 5—6 ..		40	90%	36
Primary	5—6 to 10—11 ..	1—5	125	95%	119
Secondary					
	10—11 to 13—14 ..	6—11	68 } 133	95%	65 } 114
	13—14 to 10—17 ..	65	65	75%	49

The above age groups for three types of schools are based on the accepted standards now prevailing in most parts of the country.

The table below indicates the optimum population/number of families that can be effectively served by each type of school and the land area required for each assuming an average family size of 4.7 persons :—

TABLE 2.6

School size and land requirements

School	Population served No. of families	No. of children	Land requirements (inclusive of play-grounds)	
Nursery	500/320	50—60		
Primary	3500/640—700	350—400	3 acres	1·21 hectare
Primary including Nursery	3500/640—700	400—500	3 acres	1·21 hectare
Secondary	9000/1900	650—1000	6·0 to 8·0 acres.	2·43 hectare to 3·24 hectare

It will be seen from the above table that an average neighbourhood should consist of about 600 to 700 families or 3,000 to 4,000 persons so that an economic sized primary school can be located in it.

One or two nursery schools will also be required in such a residential unit. These can be advantageously combined with the primary school.

A secondary school should be provided to serve 2 to 3 neighbourhoods having a population of 9,000 to 10,000. Whereas co-education system can be adopted in the primary schools, separate secondary schools for boys and girls may have to be provided in some cases.

2.11.2. *Space and land requirements of schools.*—Primay School: For a primary-*cum*-nursery school of a strength of 400—500, the total built up area could be of the order of 11,000 sft. (1020 sq. metres). To accommodate a school of this size and also to provide adequate playing fields, a land area of 3 acres (1.21 hectares) should be sufficient.

Secondary Schools: The Committee on Plan Projects had earlier made a detailed study of higher secondary schools in Delhi. Their study indicated that space requirements were much on the higher side and the use co-efficient of several facilities was on the low side. On the basis of detailed work study, the Committee have laid down standards for higher secondary schools catering to strength of 650 rising to 1,000. On this basis the total built up area could be of the order of 30,000 sft. and 42,000 sft. (2784 to 3898 sq. metres) for schools having a strength of 650 and 1,000 pupils respectively. For a school of this type, a land area of 6 to 8 acres (2.43 to 3.24 hectares) would be needed inclusive of the playing fields.

It may be desirable to have the school to cater initially to a Strength of 650 and increase it later on to accommodate 1,000 students.

2.11.3. *Academic College.*—Every industrial township may not require a college. This will depend purely on the ultimate size of the town. If the town has to cater to a population of about a lakh and a half, the need for a college may arise at a future date. Space may have to be allocated for this purpose in the early stages of planning. An area of about 15 acres (6 hectares) should be normally adequate for such a college.

2.11.4. *Technical/Vocational School.*—As the country gets more and more industrialised the need for technical training is bound to increase. We feel that sites for one or two technical schools depending upon the size of the town should be earmarked in the initial planning stage in suitable locations so that no difficulty is encountered later on. An area of 12 to 15 acres (5 to 6 hectares) should be adequate to provide for all the facilities of such an institution including hostels and playgrounds.

2.11.5. *Residential accommodation for the teaching staff.*—In industrial communities, residential areas will always be fairly close to the teaching institutions. We, therefore, feel that there is no necessity to provide for residential accommodation of teaching staff on the campus. They can be allotted quarters in the residential area nearby.

2.12. **Recreational facilities**

2.12.1. Parks are essential requirements of every town, sector and neighbourhood and it is not enough merely to provide an adequate area for them. An equally important consideration is the proper distribution of this area in the layout of the town, sector and neighbourhood. It has been common practice to provide a number of green patches in various parts of the layout often surrounded by roads to the detriment of the children and the aged. Another way for siting of parks in sectors is to have them in the form of continuous park strips of varying widths running from one sector to another with schools and other public buildings abutting them. Suitable branches of the main park strips can lead to areas in the neighbourhood so that in a majority of cases the school children as well as the public can reach the school and other buildings without crossing any roads as far as possible. Such a pattern of park layout fits in snugly with the dual circulation system mentioned elsewhere which provides for two distinct systems of transportation, one for the pedestrian and the other for vehicles. It is recommended that 3.0 to 4.0 acres (1.21 to 1.62 hectares) per 1000 of population be allowed for under this category. This could be spread out in the township according to scales indicated below :—

2.12.2. *Tot lots and Children's Parks.*—Special attention should be given to the provision of open spaces for children by way of tot lots (for infants up to 2½ years age) and children's parks. A tot lot should not be less than 2,000 sq. ft. (186 sq. metres) for every 500 of population and should be located suitably between residential plots.

In addition to tot lots, a children's park of about 5000 sq. ft. (464 sq. metres) should be provided in each neighbourhood.

2.12.3. *Neighbourhood playgrounds.*—Neighbourhood playgrounds are very essential to provide outdoor recreation and playing space for boys and girls of the teen-age group. A size of 2.0 acres (0.81 hectares) should be provided for such purpose.

2.12.4. *Neighbourhood and sector parks.*—An area of about 1.5 to 2.5 acres (0.6 to 1.0 hectare) is considered necessary for a neighbourhood park whereas for a sector park an area of about 10 acres (4 hectares) can be allocated.

2.12.5. *Central Park.*—In addition to the parks in each neighbourhood and sector there should be a central park in the township. This can be located near the civic centre complex. The area of the central park should depend upon the population but a minimum area of 30 acres (12.14 hectares) is considered desirable for this purpose.

2.13. Medical facilities

2.13.1. *Hospital.*—The two main factors to be considered in respect of the hospital is the number of beds to be provided and its situation in relation to the residential area. In most of the industrial townships recently built, the number of beds varies from 1 to 4 per thousand of population.

2.13.2. In a few cases, the main hospital has been located at a far distant place, leading to transport difficulties. But easy transport is not the only consideration for the location of a hospital. There is also a psychological factor which has to be considered. The inmates of a hospital located at a far distant place from the town feel segregated, lonely and neglected and such a feeling has an adverse psychological effect on their early recovery. It is, therefore, desirable that the main hospital should be located neither in the centre of the town with all its noisy atmosphere nor on the fringes of the town for reasons mentioned above but midway between the two extremes.

2.13.3. As regards planning of the hospital itself we have seen wide variations in regard to the facilities provided, their grouping and areas allotted for each department.

2.13.4. While fixing the number of beds, it would be advisable to take into cognizance the hospitalisation facilities that the Employees State Insurance Corporation would be providing. In the absence of such coordination, it is quite possible to make the provision on the higher side as was seen in one or two cases studied by us. The number of beds in the hospital for different sizes of population can be as follows :—

TABLE 2.7

*Bed strength of hospitals**

Population	Number of beds
10,000	30
25,000	75
50,000	125
1,00,000 and above	2 beds for 1,000

2.13.5. The requirements of hospitals of varying bed strength are briefly mentioned in *Appendix III*. We would emphasise that a hospital for 25 beds should be ultimately capable of being expanded to 50 beds and a hospital initially planned for 50 beds should be capable of being expanded to 100 beds. The requirements listed in the appendix are based on this basic planning concept. The ancillary facilities have been so proportioned that they can without further expansion meet the additional requirements of bed strength. This will facilitate the construction of wards in a phased way.

2.13.6. The hospital should preferably be 2 to 3 storeyed. The planning of the hospital must be such that it should be possible, as mentioned before, to add an additional ward without affecting the functioning of the hospital. The out-patient department should be capable of being expanded to accommodate additional departments as and when needed. A schematic diagram of a hospital showing the relative positioning of the various facilities is given in *Appendix IV*. An important feature of this schematic diagram is the placement of diagnostic and treatment facilities in such a way that they are capable of being utilised effectively both by the out-patient and the in-patient departments. The out-patient and in-patient facilities for the maternity and gynaecology departments have been grouped together as this is found to be functionally efficient and at the same time affording the desired degree of segregation and privacy.

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*As a well-equipped hospital may serve some of the public from neighbouring areas, it may be necessary to make provision for the same in calculating the beds. For this purpose we recommend that depending upon the location of the township, an addition upto 5% may be made to the population of the proposed town and then arrive at the bed strength as given in Table 2·7

2.13.7. The considerations in the planning of several sections of the hospitals, the mode of construction and specifications to be adopted and services to be provided are discussed in detail in the Report on Hospitals of the Committee on Plan Projects. This report should be usefully referred to by the authorities incharge of planning of townships. Land required for hospitals of varying bed strengths can be as follows :—

25 beds	5	acres	2	hectares
50 beds	10	acres	4	hectares
100 beds	15	acres	6	hectares

2.13.8. If different townships are closely located, the possibility of sharing a bigger central hospital could be looked into as that will enable the authorities to provide for better medical facilities at a lesser cost. This consideration holds good with greater force in respect of hospitals offering specialised treatment as in the case of T.B. etc.

2.13.9. *Health Centre.*—A population of about 20,000 may require a health centre. These centres will function only as dispensaries rendering out-patient service, as in-patient facilities would be provided for in the main hospital. Construction of this can be taken up after the sectors develop to their full capacity. In the initial stages, land to an extent of 1.0 to 1.5 acres (0.40 to 0.61 hectares) need only be reserved.

If a township is designed for an ultimate population of 20,000 it will obviously not require a separate health centre as the hospital itself will meet the requirements.

A built up area of about 5000 sft. (464 sq. metres) would be adequate to meet the needs of the health centre consisting of doctors' consultation and examination room, dispensing section, medicine stores, patients' waiting hall etc.

In planning, the services that would be rendered by the Employees State Insurance Corporation should be coordinated, as failure to do so would lead to needless duplication of costly equipment and facilities.

2.13.10. Residential accommodation for the staff of hospital and health centre, should be provided for in their vicinity.

2.14. **Shopping facilities.**

2.14.1. We recommend that shopping centres should be provided in the neighbourhoods, sectors and in the town centre on the basis of 6 shops per thousand of population. This is considered to be the minimum desirable standard. The project authorities should distribute the shopping facilities in suitable proportion in the neighbourhoods, in the sectors and in the central business area of the town centre.

2.14.2. We feel that each neighbourhood should be provided with 6 to 10 corner or convenience shops to cater to the needs of the families living in the area. Each shop may have an area of 100 to 150 sft.

(9.00 to 14.00 sq. metres). These shops would be for general provisions, vegetables and other day-to-day requirements of the people in the residential unit.

2.14.3. The sector shops may be 150—200 sft. (14 to 20 sq. metres) each. These should provide for a wider variety of community needs including service industries etc. The shops of the neighbourhood and sector should be built by the industry itself and let out.

2.14.4. The town centre should have larger shops to cater to the needs of the entire town. Some of the shops in the town centre may be constructed by industry itself. There must be provision for additional shops to be built by the private enterprise on sites earmarked for the purpose in the town centre. Area per shop in the town centre may be 250—300 sft. (24 to 28 sq. metres) and even more. The above standards are for shops only and exclude residential accommodation for shop purposes.

2.14.5. It may be advisable to provide for residential accommodation on the first floor for the sector shops and those in the town centre. No such provision is necessary for shops in the neighbourhood.

2.14.6. The shopping area in the town centre should invariably be planned on a pedestrian pattern so that vehicular traffic is kept out of its precincts. The shoppers must be able to move around with complete freedom without any danger whatsoever from vehicular traffic. The central shopping area should also have, near to it, a separate wholesales market and a vegetable market. These facilities can be provided only in the town centre. The shopping area should be properly designed to give adequate facilities for loading and unloading of goods, and for parking of cars, trucks and other vehicles.

2.15. Community Centres and Clubs.

2.15.1. Adequate provision of land should be made for community centres in the layout. One such centre can cater to the civic needs of two sectors having a population of about 20,000. It is felt that an area of 3 to 4 acres (1.21 to 1.62 hectares) should be adequate for the purpose.

2.15.2. In addition to the above, land should also be earmarked for clubs at suitable points in the layout. The area for such clubs should be between 1½ to 2 acres (.61 to .81 hectares) and their number will again depend on the size of the town. One club for 20,000 to 30,000 of population is considered desirable.

2.16. Town Centre.

2.16.1. Besides local amenities provided within the neighbourhood and the sector there are a number of other community needs such as theatres, museums, stadium, hospitals, hotels and restaurants, police and fire stations, large shopping centres, wholesale markets etc. which have to be provided for to serve the entire town. These cannot generally be provided until a major portion of the town is developed. Adequate area for use at a later stage, therefore, should be earmarked for building a town centre which shall include the whole range of town level activities. This town centre shall form the core of the new town. The trends in shoppers' behaviour show that they combine shopping with entertainment, recreation and other leisure time pursuits. The town centre should therefore be planned as a single complex dividing the various functions in four areas *viz.*, (*i*) the business and the commercial area to provide large shops and commercial offices (*ii*) entertainment and recreational areas, to provide cinemas, theatres etc. (*iii*) cultural areas to provide libraries, museum and art gallery etc. and (*iv*) civic area having the town hall, town administration building, post and telegraph office and also the central fire station.

2.16.2. As the need for all these facilities will not be felt till the town grows to a sufficient size, the development of the town centre should be suitably phased. Detailed plans for the town centre must be prepared well in advance to ensure, systematic and planned development. A well designed town centre must provide for segregation of vehicular and pedestrian traffic so that all pedestrians, within the shopping precincts can enjoy complete freedom of movement without any danger of being run over by automobiles.

2.16.3. We feel that it is not possible to lay down any cut and dried formula for the land required for the town centre. The precise area for the town centre will depend on many factors including the shopping policy adopted, the standards of openness or compactness, the amount of space required for public gardens, if any, within this area and car parks. Its size will depend upon to what extent the town centre will serve as a shopping centre for the surrounding area also. Whilst it would be wrong to cramp the centre, it would also be most undesirable to go to the other extreme and provide for open development. Land allocation at the rate of 0.75 to 1.00 acre (0.30 to 0.40 hectare) for each thousand of population may be reasonable.

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2.17. Other Town facilities.

2.17.1. As regards the land requirements of other public buildings, *viz.*, post office, telegraph office, police station etc., these are governed by the stipulations of the departments and the load they have to handle. The branch post office in a sector could conveniently be situated in one of the shops therein and no separate provision is required to be made for this. An area of half to one acre (0.20 to 0.40 hectare) for a police station should be adequate. The main post office can be located with advantage in the town centre.

2.17.2. Besides the above facilities, there are other elements which are to be provided for in a town plan. These will depend upon the importance of the industry, size of the town and its location.

2.17.3. Suitable areas will have to be provided for cemetries and cremation grounds. Sites for religious buildings in appropriate locations will also have to be provided for. Care, however, should be taken that land earmarked for religious use is not allowed to be used for other purposes, such as shops, etc.

2.17.4. In planning big industrial towns, provision may be made for a dairy farm at a later date. Area for this will have to be earmarked on the fringe of the town in the master plan. This can be ideally situated in the peripheral belt where there is adequate green land.

2.18. **Pattern of Land use — Suggested Norms.**

2.18.1. The land use pattern in some recently constructed townships, as mentioned earlier, varies widely. This is due to lack of any prescribed norms and standards for land use planning. We have attempted in the earlier paragraphs to fix standards of community facilities to be provided, the widths and pattern of roads and communication systems and the density standards for residential areas. The adherence to these will lead to a structure of land use at the sector level as given in the table below :—

TABLE 2.8

Land use table for a sector

Uses	Percentage of developable area
1. Residential plots	45—50
2. Roads and streets	15—20
3. Schools (including their playgrounds)	12—15
4. Parks	8—10
5. Shopping	2—4
6. Other uses	Balance
TOTAL	100

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2.19. The standards laid down in this section of the report are intended to serve as a guide to the town planner so that he can bring his creative ability into play without being extravagant in the various aspects of planning. In some cases, situations may arise which will call for some modifications in the standard, but as the same have been evolved on a fairly liberal basis, any wide variation from these will have to be justified.

It is hoped that the adoption of these standards will realise the objective aimed at, *viz.* uniformity in the level of services and amenities, safety and efficiency combined with economy in construction and maintenance of the townships and what is more, full enjoyment of the community life for the citizens.

3. Public Utilities and Services

3.1. In section 1 of the report, we have mentioned that the Regional Planning and Development Authority would take steps for the implementation of necessary works required for the development of the region, such as provision of a network of transport and communication systems, power, drainage, sewerage and water-supply. Within the framework of such a regional plan, the authorities in charge of individual industries would take up the detailed planning and provisiôn of services in their own areas. There are a number of considerations which govern the provision of these services. We are referring to these in the following paragraphs.

3.2. **Water Supply.**

3.2.1. *Considerations in developing a source.*—Water is the life and blood of industry. While fixing up the source of water supply, care should be taken to see that it is capable of being developed in stages to meet the ultimate demand of the main industry, ancillary industries and the township. If it is not possible to meet the ultimate requirements from a nearby source, additional sources should be investigated in the early stages and a blue-print prepared for the phased augmentation of the water supply.

The studies of the Committee on Plan Projects have shown that water supply schemes have suffered due to want of sufficient co-ordination between various agencies, especially in regard to water resources available in the area and the method of their utilisation.

There is thus the need for making a comprehensive qualitative and quantitative survey of the water resources available in a region. A co-ordinated plan to meet all the uses with a regulated scheme of priority should then be prepared. The method of 'first come first served' can prove very detrimental to national interests.

3.2.2. *Per Capita allowance for Water Supply.*—In an industrial township, water is required for domestic consumption, manufacturing process (process water), fire fighting and arboriculture. As far as domestic consumption is concerned, we have noted in the industrial townships visited by us that the allowances vary from 20 gallons to 100 gallons *per capita* per day.

Whereas 20 gallons *per capita* is considered low, 100 gallons *per capita* per day is much on the high side. A supply designed to give 40—50 gallons (180—225 litres) per head per day should be satisfactory. This design figure excludes industrial requirements and watering for public parks and open spaces.

3.2.3. *Phasing of Water Supply Scheme.*—In some cases, where water supply systems have been designed and constructed for the ultimate population, the present population which is only a fraction of the ultimate, gets more water than necessary. This leads to wastage of water and extravagance on the part of the people and their eventually acquiring a habit of using more water than necessary. This practice should be stopped. Water supply systems should be expanded according to a phased programme. Where this is not possible, supply should be regulated at the rate of 40 to 50 gallons (180—225 litres) per head per day from the very beginning.

3.2.4. *Single* versus *Dual System of Water Supply.*—In some townships, we have noted that separate mains and distribution systems exist for domestic supply (including fire fighting) and arboriculture. This arrangement in our opinion is not only costly but also not desirable from public health point of view. Where two such separate systems exist, there is a likelihood of the unfiltered water being used for domestic consumption. We would, therefore, recommend the adoption of a single system of water supply for all purposes.

3.2.5. *Combination of Domestic and Process Water Supply.*—The requirements of process water depend upon the type and nature of the industry. In the initial stages, it should be investigated whether the water for the industry and the township can be conveyed in the same common main from the source. In many cases, the process water for the industry may not require that much of treatment as drinking water.

Filtration and other treatment works will be necessary only for domestic water supply. Where, however, process water has got to be specially treated, works for that purpose could be placed conveniently within the factory area itself or in its vicinity.

3.2.6. *Continuous* versus *Intermittent Supply.*—In some of the townships visited, intermittent system of water supply is existing. When once proper sources have been tapped for supply of water at the rate of 40—50 gallons (180—225 litres) per head, we do not see the necessity of the supply being intermittent. In an intermittent system, there is a likelihood of the supply being contaminated from outside sources and there is also a tendency on the part of the householder to store more water than is necessary and throw it away when fresh supply is made available. This results in waste.

3.2.7. *Design Consideration.*—Regarding the design of the water supply installation itself, we would like to make the following remarks. The water supply system can be split into three distinctive parts: (1) Headworks (2) Conveying main and (3) Distribution system. The type and nature of head works and the conveying main depend upon local conditions. But the distribution system is capable of standardisation to some extent. In spite of this, we found that the cost of distribution per dwelling unit varied from Rs. 335 to Rs. 490. Some variation will of course be there depending upon the type of soil and nature of terrain but the wide variation noticed was mainly due to differences in the design criteria for the distribution system, density of population and the pattern of layout of buildings.

We have given recommendations in an earlier section regarding densities and pattern of layout, the adoption of which will result in a compact town plan with the attendant advantage of economy in services. With regard to design criteria, we have mentioned that the supply must be regulated at 40—50 gallons (180—225 litres) per head per day. We will also recommend that the distribution system be designed for 1½ to 2 times the average demand with a continuous supply. These stipulations will lead to economy in the cost of distribution and reduce the variations in cost.

3.2.8. *Choice of Material for Pipes.*—The choice of material for pipes for the distribution system is also an important factor. In many cases, cast iron pipes have been indiscriminately used, where asbestos or spun concrete pipes would have proved adequate. The Panel on National Water Supply and Sanitation Schemes set up by the Committee on Plan Projects have recommended that lower class of C.I. pipes suitable for lower pressures should be manufactured, as in the absence of this, the tendency is to specify B class pipes which is the lowest class at present manufactured. In many of the distribution systems heavy pressures are not met with and the use of B class pipe would be wasteful. We endorse this view and recommend that steps should be taken to manufacture a lower class of C.I. Pipe. At the same time, the designer should make a judicious choice of other types of pipes, such as, spun concrete pipes, asbestos pipes, pre-stressed concrete pipes etc. to suit the requirements.

3.2.9. *Water Treatment.*—With regard to treatment to water, we feel that the design criteria adopted at present have ample scope for improvement. Research has proved that it is possible to reduce the detention period in clarifiers and increase the rate of filtration of rapid sand filters. These factors should be given due consideration, while planning water treatment works or calling for quotations for them.

3.3. **Sewerage.**

3.3.1. Our studies revealed that there is a wide difference in the cost of sewerage. It varied from Rs. 700 to Rs. 1,600 per dwelling unit. The reasons for variation are mainly (*a*) density of township, (*b*) character and layout of buildings, (*c*) the nature of terrain and soil and (*d*) design considerations. Our earlier recommendations regarding density and pattern of layout of buildings will to a great extent reduce this variation.

3.3.2. *Design Consideration.*—House connection through saddle junctions should be avoided as far as possible. Connections should always be made through manholes. The house drains should be properly ventilated through soil pipes attached to buildings.

In the design of the sewerage system, considerable attention must be paid to the selection of materials for sewers to suit the conditions of flow. It is usual to use salt glazed hardware pipes for house connections and branch sewers and concrete pipe or brick barrel for bigger diameter sewers, with adequate arrangements for ventilation.

3.3.3. In the initial stages of a sewerage scheme, self-cleaning velocities are not obtained and consequently the sewers are required to be kept in a clean condition by artificial means. A small gang of workers with proper cleaning equipment should be included in the staff of the township from the very commencement.

3.4. Sewage Treatment.

3.4.1. It is imperative to treat the sewage before letting it into any water course. The degree of treatment will depend upon the nature of the receiving waters.

3.4.2. The treatment of sewage is effected in two stages, *viz.*, primary and secondary. Primary treatment is effected through clarifiers while secondary treatment can be done on land or through the installation of biofilters, activated sludge plant etc. Where land is available, the possibility of secondary treatment of sewage through sewage farming or waste stabilization ponds (Oxidation ponds) should be explored. Treatment through waste stabilisation ponds has become popular, for small and medium installations in the U.S.A. These ponds, however, must be properly designed, constructed and managed, if fly and mosquito nuisance is to be eliminated. A detailed note on waste stabilisation ponds is given in *Appendix V.* We emphasise the need for exploring the possibility of secondary treatment on land either through well controlled sewage farming or by the provision of oxidation ponds before deciding upon other costly treatment works, such as, the activated sludge plant or high rate trickling filters.

3.4.3. *Disposal of Sludge.*—The primary and secondary treatment in the conventioned plants create the problem of sludge disposal, which is as important as the disposal of sewage. For dealing with sludge, digestion tanks are required to be provided which are rather costly and the gas generated from which cannot always be economically used. But if oxidation ponds are properly designed and worked efficiently, the problem of sludge disposal gets eliminated.

3.4.4. *Treatment of Sewage in the Initial Stages of Town Development.*—In industrial townships, there is also the problem of treating the sewage in the initial stages, when the town is growing up. At present, treatment is given in septic tanks, the effluent from which is allowed to soak into land. The possibility of adopting oxidation ponds in place of septic tanks can be explored. Where septic tanks are used, suitability of the soil for the absorption of the septic tank effluent should be ensured, as otherwise the results will not be satisfactory. The sewers leading to the septic tank should be so designed that they get eventually absorbed in the final sewerage system.

3.5. Storm Water Drainage.

3.5.1. In designing storm water drainage, advantage should be taken of natural water courses in the area by canalising them, where necessary. Normally, the storm water drainage system is designed for a storm intensity of half an inch to one inch per hour. In regions where the intensity of rainfall is heavy, its duration long and frequency of occurrence high it may be necessary to design the storm water drainage for a higher figure.

The normal practice is to go in for open drains up to a depth of 3′ and underground RCC pipes or masonry barrels for greater depths.

3.6. Street Lighting.

3.6.1. *General Consideration.*—A well designed street lighting system should make it possible to recognise the presence of an object but not necessarily its finer details. There are many factors which influence the planning of a street lighting scheme and generally a good installation is the result of achieving the best visibility consistent with relatively low cost per unit of light. Some traffic centres require special lighting. In designing street lighting, the governing factors are, therefore, traffic density, road layout, type of road surface and junctions.

Dr. Walrauf, an eminent illumination engineer, considers that good street lighting is one in which motorist can drive at the designed speed of highway without the use of headlights, so that he can see an object on the road within safe stopping distance. In towns where the speed limits vary from 30 to 35 m.p.h., the safe stopping distance is about 130 ft. If the motorist can see an object within 130 ft. without the use of headlights, the lighting standard will fall under the category of 'good lighting'. In an industry where shift working is resorted to, the standard of street lighting in the township should be better to facilitate the movement of workers to and from the factory at night.

3.6.2. *Suggested Standard.*—We would suggest single row of lighting for sector roads and double row for main roads. The lighting poles may be spaced at 100′ intervals. Fluorescent tubes could be used with advantage on the main roads, as they are economical in the long run. For other roads, incandescent lighting may be sufficient.

3.7. **Electric Transmission.**

3.7.1. As regards transmission, underground cables, though costlier, are better in the long run. If placed initially well remote from carriage ways, the underground wiring system will not interfere with future widening of roads. In order to prevent frequent opening of roads for maintenance of the various utility services, it is recommended that their location should be suitably decided upon in the early stages. It is preferable to locate these under the bores and footpaths, where possible.

3.8. **Refuse Collection and Disposal.**

3.8.1. *Collection of Refuse.*—The problem of refuse collection and disposal has become very acute in most of the growing towns in the country. This is mostly due to the inadequate provision for refuse collection in the initial stages and the lack of civic consciousness among the public. Care, therefore, should be taken to provide for properly designed enclosures at suitable places in the new townships for depositing refuse from houses. From these places, refuse can be collected by covered lorries and taken to the places of disposal.

3.8.2. *Disposal of Refuse.*—Regarding disposal of refuse, several methods are available, namely, incineration, controlled tipping, composting etc.

Incineration is a very costly method of disposing of refuse and cannot be resorted to except on a very small scale.

Where low lying lands are available, controlled tipping can be adopted and these areas can be developed into gardens or playfields at a later date. The tipping operation should be adequately controlled to avoid fly and mosquito nuisance.

Composting is by far the best method of refuse disposal, as that would yield manure, which could be profitably utilised in the town itself for gardening operations and even sold to agriculturists in the neighbouring areas. Where composting is adopted and where facilities for marketing the manure are available, land at two acres (.81 hectare) for 10,000 of population should be set apart in suitable locations in the initial stages of planning.

3.9. **Transport.**

3.9.1. The problem of transport should be looked into at the very early stage of planning the town. The need for a local public transport system can be avoided in the case of small and medium industrial towns, if they are planned in a compact manner. But in the case of big industrial towns, the problem of transport cannot be overlooked. The road pattern of the town must be such that public transport buses need ply only on main roads. Provisions of express cycle tracks, as mentioned earlier, will reduce congestion on main roads and make the flow of traffic smooth.

3.9.2. Suitably designed recesses on the main roads for bus stops, properly designed roundabouts and junctions would facilitate flow of traffic and attention to these details must be given at the planning stage.

3.9.3. In the case of big towns, a bus terminal can be provided at a suitable place to serve the inter-city bus traffic. The flow of inter-city traffic through the township should, as far as possible, be avoided.

3.10. **Adoption of Metric System.**

3.10.1. Wherever standards are given in the report, the metre equivalents have been mentioned. The National Buildings Organisation has done valuable work in compiling a handbook for Engineers based on metric system. The authorities in charge of planning of industrial towns will find this handbook useful.

3.11. **Check Lists to Facilitate Authorisation of Projects.**

3.11.1. In this, as well as the previous section, we have listed the various considerations governing the preparation of a town plan and the standards that are to be attained. A check list indicating all these points and the norms suggested by us is included after the Summary of Recommendations.

It will be a good practice, if the project authorities fill up this check list while forwarding projects for sanction. This would enable the sanctioning authorities to get at a glance the points that are to be considered, the norms suggested and the extent to which these are realised in a particular case. The submission of such a check list will facilitate checking and quicken the process of authorisation at different levels.

4. Administration

4.1. Special Features of Industrial Townships.

4.1.1. The economical planning and building up of a township is only one part of the job. it has to be efficiently administered as well, as on this, depends to a great extent the employees' satisfaction. Several problems arise which are required to be dealt with adequately in the administration of industrial townships as they differ much from other normal towns. Firstly, these towns are built out of the capital grants to the industry and all civic amenities and services are also provided for out of such grants. The township is inhabited mainly by the employees of the industry and their supporting population, such as, shop owners, private doctors etc., whose services are required by the employees. The administrative machinery for such a township must be on a different footing.

4.2. Existing Set-up.

4.2.1. For internal administration, most of the projects have a Town Administrator who exercises control over the township including its services and amenities. In some States like Mysore, the public health aspects of the township containing more than 1000 houses are controlled by a Sanitary Board comprising the representatives of the States as well as the Industry concerned.

4.3. Problem of Township Administration.

4.3.1. The real problem in town administration arises with regard to exercising the rights of local authorities in the matter of taking action against unauthorised encroachments, issue of licenses to cycle rickshaws, tongas, eating establishments, cattle pounding etc. There has been no uniform approach in the matter of endowing the administration of industrial townships with such powers.

4.4. Need for Special Legislation for Township Administration.

4.4.1. The Municipal function of towns and cities are carried on by Notified Area Committees, Municipal Committees, City Corporations or Cantonment Boards. The powers and authority of these bodies are more or less the same in all the States and are regulated by the respective State enactments. Notified Areas are constituted for small towns, Municipal Committees for big towns, Corporations for cities and Cantonment Boards for military stations.

4.4.2. Every industry would prefer to have a separate Notified Area Committee for its administration as this will result in unitary control. In respect of industrial complexes with a few major and subsidiary industries under different managements the problem becomes more complicated. In places like Durgapur, Rourkela etc., separate Notified Area Committees function independently of each other. The State Governments, however, are more interested in effecting integration of such different Notified Area Committees and including in them a number of villages roundabout as this measure will give indirect relief to the villages.

4.4.3. This, however, is fraught with a number of difficulties. The main industry can only look after the community facilities of its employees and the necessary supporting population. It cannot have the resources to extend these facilities to the entire population coming under the Notified Area Committee. This will naturally lead to differences in the standards of services and facilities provided in the area which may bring about dissatisfaction. Apart from this, there will be other difficulties about taxation.

4.4.4. If the authorities are empowered to collect taxes from the non-employee population, they are likely to face the problem of giving representation for the tax paying public in the Committee. This will ultimately lead to industrial authorities not having control over the township which is so essential not only for its administration but for the progress of the industry itself.

4.4.5. Taking these into consideration, we feel that the administration of industrial township should vest fully with the industrial authority as is the case with Military Cantonments where the defence authorities have effective control. This requires the enactment of suitable legislation. We, therefore, recommend that the Government of India take immediate steps to formulate and enact such a legislation.

4.5. **Administrative and Financial Considerations in the Planning of Amenities, Public Utilities and Services.**

4.5.1. The various amenities and facilities that have to be provided for the town as a whole, neighbourhood and the residential units have been detailed in the preceding sections. It will not be out of place to consider a few points about the financial and administrative implications in the provision and management of these amenities.

4.5.2. It is true that community facilities and services like schools, health centres, clubs, water supply etc. should be provided to make living healthy and happy and thereby attract workers to the industries. If, however, these are taken to the extent of giving free water supply and electricity, it will surely lead to abuse of these facilities which will have repercussions on the project itself. We, therefore, feel that health, education and transport facilities could be subsidised to some extent but water supply and power should be paid for by the workers according to their consumption.

4.5.3. So far as the supporting population is concerned, there should not be any grouse in their partaking the community facilities provided for workers. We would recommend that suitable higher rents be recovered from such persons (for land and buildings) to cover the cost of these community facilities enjoyed by them. For electricity and power, they would be required to pay according to tariff.

4.5.4. Regarding education, it may be mentioned that it is a State subject. It is for the State Authorities to plan educational facilities of an industrial township on the same lines as for any other place in the State. At the same time, the industry is also interested in getting these facilities quickly in order to attract and retain the workers.

From practical considerations, we would suggest that the industries themselves provide these facilities to start with. The State Government may make usual grants available to the industries in order to reduce the burden of expenditure. It is also necessary that the industrial undertakings should be exempted to some extent from the normal departmental rules obtaining in the State for the administration of these schools.

4.5.5. As big industrial undertakings attract workers from different parts of the country, it is also necessary to encourage private bodies for putting up schools to cater to the various linguistic sections of the population.

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5. Avenues of Cost Reduction

5.1. Need for Cost Reduction.

5.1.1. A report on industrial townships cannot be complete without a reference to the need for cost reduction in the planning and erection of such townships and the ways and means of achieving it. This question is important not only because of the huge outlay on industrial townships in the present plan but because of the continuing need for putting more such townships in the future plans. The subject of cost reduction and its various aspects have been outlined by the Committee on Plan Projects in the publication entitled "Scheme of Cost Reduction". The general principles mentioned in this are as much applicable to industrial townships, as they are to any other enterprise. However, some specific avenues of cost reduction in the planning and construction of industrial townships are discussed in the succeeding paragraphs.

5.2. Scope of Cost Reduction.

5.2.1. The studies of the Committee on Plan Projects have proved that there is immense scope for cost reduction in almost all stages through which a project has to be processed starting from the authorisation to the completion of works, but at the initial stages of planning, the scope is relatively greater.

5.2.2. In an industrial project the cost of township only should not be taken as an index of the building activity. A substantial portion of the outlay of the industry is towards the cost components of factory and allied types of buildings. Hence, it is evident that considerable attention must be paid to the cost aspect of building activities whether of the factory or the township.

5.2.3. We would also mention that the training of staff has a significant part to play on this important subject of cost reduction. The staff should be made to take lively interest in the subject of cost reduction and spare no efforts to find out ways and means of how cost could be reduced.

5.2.4. It can be argued that factory buildings are tailor-made articles and as such rough and ready rules cannot be applied. The general principles of factory layout and construction, however, have been studied in detail by a Team sponsored by the National Productivity Council and their report* contains several useful recommendations for the efficient planning of factory buildings and their economical construction. This report can be usefully referred to by the authorities in charge of industrial undertakings.

5.2.5. In the following paragraphs, however, we are mentioning some avenues of cost reduction which are principally meant for the township, though some of them can have equal application in the construction of the factory buildings as well.

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*N.P.C. Team Report on Factory Layout and Construction in Japan, the U.S.A. and Italy.

Copies available from the National Productivity Council, 38, Golf Links, New Delhi.

5.3. Cost Reduction in the Planning of Townships.

5.3.1. There are three stages in the development of a township each one of which affords ample opportunities for cost reduction. The first stage is that of regional planning. In an earlier section, we have recommended the setting up of a Regional Planning and Development Authority, as soon as the decision to establish a particular industry in a region has been taken. Setting up of this authority would lead to the preparation of an integrated plan of development for the whole region. It will do away with piecemeal planning by individual authorities, as is happening at present. It will also avoid the uncoordinated development of services by individual undertakings, which cannot but lead to duplication of efforts and increase in their capital as well as running costs. The planning and development of services in an integrated manner will thus constitute a major step towards cost reduction.

5.3.2. The next stage is the preparation of a master plan for the township. We have already indicated that a comprehensive master plan should be drawn up by a well-qualified team in which all technological disciplines are represented. We have also detailed in the earlier sections the standards of the facilities such as education, recreation, health etc. that are to be provided for in the town. The preparation of a master plan based on these standards would be the next major step towards cost reduction.

When once a master plan is prepared the development of the township can be suitably phased. Our study of Industrial Townships both in private and public sectors, has revealed differences in the method of approach to this problem.

Private undertakings generally build up the township in gradual stages. This has the effect of reducing capital investment in the first instance. Standards of amenities also improve as years go by. These result in the township growing along with the industry. A notable example is the Tata Iron and Steel Company of Tatanagar which has been built in a gradual manner. In the industrial township at Walchandnagar also, similar policy had been adopted. In contrast to these, in public undertakings, there is a tendency to develop all amenities and utilities to the full extent in the initial stages itself. This naturally leads to over capitalisation.

We recommend that while with regard to essentials, there should be no compromise, a phased programme could be evolved for providing certain other facilities which may not be utilised to the full extent in the early stages of development of the town. For example, roads need not be constructed to the full width in the initial stages. One or two traffic lanes as required may be constructed to start with and expanded later according to needs. Similarly, the construction of clubs, community centres and civic centre can be phased in such a way that they grow with the needs of the growing population.

5.3.3. The third stage in the development of a town is the planning of residential and other buildings and services. With regard to residential buildings, a number of suggestions for cost reduction are given in the report of the Committee on Plan Projects on "Residential Buildings". Similarly the reports on School Buildings, Hospitals etc. of the Committee on Plan Projects also outline considerations for cost reduction in these types of buildings.

In general, for any building, cost reduction starts from architectural planning. In the subsequent stages of structural planning, costing, etc., there is further scope for cost reduction. Three of the important considerations at this stage especially for industrial townships are (*a*) diversification of specifications (*b*) greater stress on pre-fabrication (*c*) use of by-product from Industries.

5.3.4. *Diversification of Specifications.*—It is obvious that the adoption of uniform specifications for mass construction will result in spiralling of cost due to artificial boosting up of demand for certain categories of materials and construction equipment. It is of paramount importance to diversify the specifications.

Specifications should also be realistic and need not be superior to what the situation demands. There is the tendency to specify materials on visual or place standards *viz.* blue metal from a particular quarry, river sand from a particular river. This creates monopoly for certain sections of the trade without any corresponding advantage to the project. Further, this serves as an obstacle for the development of new quarries, or sources of materials. It is important that materials should conform to technical standards as laid down in the relevant Indian Standards. Hence, we would suggest that in the matter of specifications more stress be laid on the technical requirements rather than on a place, a colour or manufacture.

5.3.5. *Greater Stress on Pre-fabrication.*—There is considerable scope for adopting the technique of pre-fabrication, especially where there is concentrated building activity. In addition to securing cost reduction, pre-fabrication saves time and enables a more judicious use of available materials.

A notable instance, where pre-casting techniques have been used extensively is the Neyveli Lignite Project. Portal frames of different spans have been adopted there for warehouses and the like. In the township at Rourkela also, there has been considerable use of precast elements in roofs, superstructure etc.

Construction of industrial townships affords ample opportunities for adopting pre-cast elements. Damp proof course, lintels, *chowkats* for doors and windows, roof members etc. are some of the conspicuous items which lend themselves easily for pre-casting. Roofing with battens and hollow block construction have proved satisfactory. This particular type of construction does not require elaborate centering or shuttering. Another type of roofing for short spans which deserves consideration is the doubly-curved concrete tiles on R.C.C. beams developed by the ~~Central Buildings~~ Research Institute, Roorkee.

There has been some difficulty experienced in fixing doors and window shutters to RCC *chowkats*. An improved method of doing this has been outlined in the report on Residential Buildings of the Committee on Plan Projects. The Central Buildings Research Institute have also recently evolved a method which is quite simple and satisfactory.

5.3.6. *Use of by-products from Industry.*—When a Steel Plant goes into production, considerable amount of slag is available which in most cases is dumped in low lying areas. In some places, dumping itself is becoming a problem due to want of space. In other countries, blast furnace slag has been put into effective use in different ways.

It can be used as road metal for roads which do not carry heavy vehicular traffic. It will be a good practice to use the slag for the expansion of road system in the township in lieu of conventional stone metal.

Air-cooled slag can be used as aggregate for concrete making. Experiments carried out in the Central Buildings Research Institute at Roorkee show that concrete prepared with crushed slag aggregate was found to possess compressive and fluctural strength of the same order, as that prepared with local stone. The slag concrete was also found as weather-resistant as ordinary concrete. Industrial townships near the steel plants should fully utilise such air-cooled slag which will not only enable cost reduction but also help in clearing the slag dumps which accumulate day by day.

Foamed slag can be used as light weight aggregate in concrete. Concrete prepared with this aggregate is light in weight and possesses heat and sound insulation properties. We recommend that ancillary industries for the manufacture of foamed slag products should be put up in areas where there is concentration of building activity so as to ensure a good demand for them.

Blast furnace slag can also be used as filter media in water supply and sewage disposal works. When properly constructed, filters with blast furnace slag as filter-media can operate successfully for many years without the necessity for replacing the media. There are records for continued operation of such filters in the U.K., and the U.S.A. for periods of 30 years or more.

Another industrial by-product which can be put to constructional use is the fly ash from thermal stations using powdered coal. The Central Buildings Research Institute, Roorkee, has done considerable amount of work on the production of light weight aggregate from fly ash. A pilot plant for this purpose has also been put up. The project authorities should explore the possibilities of utilising sintered aggregates from fly ash for the lighter components of construction.

Sugar factories employing carbonation process produce huge quantities of press mud. Trials have been conducted by the Central Buildings Research Institute on the use of this press mud for making building lime. We would like to emphasise the need for intensifying research on these lines so that by-products of industries could be put to profitable use on construction.

5.3.7. *Economy in the Planning of Services.*—With regard to services some of the considerations for cost reduction have been outlined by us in section 3 of this report.

5.4. **Construction of Township.**

5.4.1. In the foregoing paragraphs we have mentioned how considerable cost reduction can be achieved through proper planning at the different levels, namely, regional level, town level and individual facilities level. Further cost reduction can be achieved in the construction stage of these facilities. Some of the main features at this stage are outlined below.

5.4.2. *Construction Agency.*—An important factor which governs cost at this stage is the agency for construction.

Where qualified contracting firms are available, it is to the advantage of the industry to encourage healthy competition amongst them and thereby establish reasonable levels of prices. As the bulk of work at present is being carried out through these agencies and considerable work will have to be entrusted to them in future, the aim should be to create such conditions as will enable the construction industry to develop on healthy lines.

Contractors actively engaged on works have intimate experience of how each item of work affects the cost and are thus in a good position to suggest ways and means of reducing cost. We would, therefore, suggest that consultative councils of contractors and engineers are held at stipulated intervals with a view to exploring possibilities of cost reduction.

It is advantageous to an Industrial undertaking to get some of its works executed departmentally. For this purpose, it should build up an adequately staffed and well-equipped nucleus, which could be pressed into service, when the tenders from contractors are unreasonable. Recently, Governmental Organisations like the National Buildings Construction Corporation and the National Projects Construction Corporation have entered the field of constructional activity. Social Welfare Organisations like Bharat Sewak Samaj are also in the field. All these should be given equal opportunities to tender for works along with the professional contractors.

5.4.3. *Departmental Manufacture of Building Components.*—We would emphasise the need for departmental manufacture of selected items. Doors and windows, precast elements such as lintels, door frames etc. are ideal for such departmental venture. Departmental manufacture of doors and windows, would not only ensure uniformity and reduction in cost, but also ensure quality of the timber, as the same could be obtained much in advance and allowed to season. Other items that can be taken up departmentally are the manufacture of bricks, cement tiles etc. and quarrying of stone.

5.4.4. *Standard Schedule of Rates.*—We have noted that many public undertakings use the P.W.D., C.P.W.D., or the M.E.S. schedules for preparing their estimates and scrutinising the tenders of contractors. Most of these schedules are not comprehensive. In addition, the nomenclature of items, the method of analysing rates etc. vary widely from one another. Considering the need for uniformity in the nomenclature of items, units to be adopted, method of measurement and the principles of analysis of rates, the Panel on Public Works Administration of the Committee on Plan Projects has recommended the preparation of standard schedules of rates on a zonal basis. When once such a schedule is prepared, it should be possible for the industrial authority to make use of the same. Till such time as the standard schedules are available, the authorities in charge of industries may, however, prepare their own schedule of rates and specifications so that discrepancies at the time of execution of works are avoided and disputes with contractors minimised.

5.4.5. *Payment to Contractors.*—Time and again, it has been brought out by several bodies that prompt payment to contractors is necessary for reducing cost of works. Still, there are cases of inordinate delays in payment and settlement of accounts. These are due to certain procedural formalities, involved in the sanction of extension of time, approval of rates for extra items, etc.

The Panel for Public Works Administration of the Committee on Plan Projects has gone into this question and has given specific recommendations for reducing delay to the minimum and to ensure prompt payment to contractors as the work progresses.

5.4.6. *Programming and Progressing of Works.*—Our studies have shown that the time limit for works fixed in an arbitrary manner is to a great extent responsible for higher tender bids resulting in a wider gulf between the cost incurred and the values realised. To our mind, this, to a great extent, is due to inadequacy of programming. Similarly bad phasing and progressing of works also lead to idle investment ahead of utility. To overcome these, the Committee on Plan Projects has earlier outlined a method of programming and progressing known as the "Line of Balance Technique". A brief resumé of this technique is given in *Appendix VI.*

We feel that this fills a long felt need for a method of scientific programming and progressing of works against predetermined levels of activity. Especially with regard to industrial townships, the works on several fronts have to be properly synchronised in order to get maximum benefit out of the money spent and this requires proper co-ordination. The line of balance technique, we feel, would be of immense help in such co-ordination and in securing proper balance in the levels of execution of the different component works.

5.4.7. *Works and Contract Procedure.*—As we have mentioned earlier, the works and contract procedure of public undertakings are more or less modelled on the practices of public works departments. There has been a long felt need for revising the rules and procedures, pertaining to public works. The Panel on Public Works Administration of the Committee on Plan Projects has studied the subject in detail and has formulated recommendations which aim at removing the existing bottlenecks, streamlining the procedure and developing an organisational pattern that would be best suited to the fulfilment of projects with speed and economy.

The need for simplifying procedures and streamlining organisation is keenly felt in public sector undertakings as well, and we suggest that the report on Public Works Administration can be usefully referred to. For ready reference we are listing the major recommendations of this report in *Appendix VII*.

5.4.8. *Delegation and Decentralisation.*—The need for adequate decentralisation and delegation of powers to various levels for the successful functioning of the industrial undertakings requires no special emphasis. The Organisation and Methods Division of the Government of India have recently worked out a scheme of delegation of powers for officers at various levels in the public sector undertakings. The main principle behind the scheme is that various managerial levels should be vested with authority and to enable them to assume and discharge the responsibility assigned to them in the fulfilment of the objective of the organisation. The authorities in charge of industrial undertakings may find this model scheme of delegation useful for effective decentralisation of work.

5.5. Reducing Cost of Maintenance and Administration of Township.

5.5.1. Before concluding this section, we would like to refer to the necessity for bringing down the cost of maintenance and administration of the township in a rational way. From the discussions which we had with the authorities of the Industrial Townships, we observed that the accounts of the factory and the township are being maintained under a combined head. This being so, it is very difficult for any one to appreciate, as to how much is being spent on the township and how the township expenditure affects the cost of production. We would recommend that a separate head be maintained for the administration and maintenance of the township. This will indicate avenues of cost reduction in township expenditure. A proforma indicating how the accounts could be maintained is given in *Appendix VIII*.

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6. Summary of Recommendations

1. The preparation of a comprehensive regional plan for the development of the 'influence' region in an integrated manner should be taken up, as soon as the preliminary decision to develop an industrial complex in a particular region is made. *(Pages* 1-2, *Para* 1.2)

2. Within the frame-work of such a regional plan, the detailed planning for individual industries and their residential areas should be taken up by the appropriate authorities. *(Page* 2, *Para* 1.3)

3. For the preparation and implementation of the regional plan, a Regional Planning and Development Authority should be set up, which should have the representation of the main industry, Central and state Governments, Railways and other interests concerning trade and commerce in the region. *(Page* 2, *Para* 1.4)

4. With a view to safeguarding haphazard development in industrial areas and preventing further deterioration of the existing areas, the Central and State Governments should enact the desired legislation for the constitution of Regional Planning and Development Authorities. *(Page* 3, *Para* 1.5)

5. Till such time as the Regional Planning and Development Authority is set up, some provision must be made to prevent unauthorised constructions coming up in between and around industrial and residential areas. The State and Central Governments may have to evolve a suitable legislation for this purpose. *(Page* 4, *Para* 1.6)

6. While determining the population to be provided for in a township, the extent and availability of housing and other facilities in the neighbouring towns and villages should be thoroughly investigated. *(Page* 4, *Para* 1.7.2)

7. Where labour force is drawn from neighbouring villages, efforts should be made to retain the workers in the villages by providing sanitary facilities and other amenities therein. *(Page* 5, *Para* 1.7.3)

8. Provision for supporting population should be made in deciding upon the size of a town. *(Page* 5, *Para* 1.7.4)

9. The practice of acquiring more land than what is necessary should be discouraged. Care should be taken not to acquire good agricultural land for industrial, residential or other uses, unless it is absolutely unavoidable. *(Page* 5, *Para* 1.8)

10. To prevent speculation on land, steps should be taken to notify the whole area under Section 4 of the Land Acquisition Act, as soon as preliminary decision for industrial development of a particular region is taken. *(Page* 5, *Para* 1.9)

11. A master plan for the development of the township should be prepared before work on any sector is undertaken. *(Page* 7, *Para* 2.1)

12. The township has to be so located that the obnoxious gases, etc. emanating from the factory shall not pollute the atmosphere of the town. *(Page* 7, *Para* 2.3)

13. In the case of heavy industries like steel, a buffer area of 1/3rd to 1/2 a mile deep should be left between the factory and the township in order to ensure fresh air and unpolluted atmosphere for the town. This can be less in the case of small plants.
(*Page* 7, *Para* 2.3)

14. In the planning of future townships and the expansion of existing ones, the following figures of density should be obtained :

Sector density: 14 to 20 dwelling units per acre.

Township density: 9 to 12 dwelling units per acre.
(*Page* 10, *Para* 2.8.2)

15. Even in the case of the expansion of existing industrial towns, the authorities concerned should make serious efforts to increase the density so as to come, as close as possible, to the figures mentioned above without sacrificing minimum living and health standards.
(*Page* 10, *Para* 2.8.3)

16. Suitable plot areas have been recommended for different categories of residential units. (*Page* 11, *Para* 2.8.5)

17. It will be a good practice, if the break-up of built up area into different categories of uses, such as living space, service space, circulation space and wall space, are indicated on the plans for residential buildings. (*Page* 12, *Para* 2.8.6)

18. For each category of house, two or three alternative designs should be prepared, so that the most suitable one for a particular location from the point of view of orientation could be adopted.
(*Page* 13, *Para* 2.8.7)

19. With a view to evolving a socially balanced and integrated community, it is desirable to skillfully group together dwellings meant for different income groups. (*Page* 13, *Para* 2.8.8)

20. Standards for roads and streets have been given. The provision of service lanes should be avoided, except in the case of row housing. (*Page* 14, *Para* 2.9.4)

21. A primary-*cum*-nursery school of 400—500 seats should be provided in each neighbourhood. (*Page* 17, *Para* 2.11.2)

22. A secondary school of 650—1,000 seats should be provided for each sector. (*Page* 17, *Para* 2.11.2)

23. Parks and recreational areas may be provided for at the rate of 3.0 to 4.0 acres per 1,000 of population. This should be suitably distributed among neighbourhoods, sectors and the central area of the town. (*Page* 17, *Para* 2.12.1)

24. The bed-strengths of hospitals should be as follows :—
30 beds for 10,000 population
75 beds for 25,000 population
125 beds for 50,000 population
2 beds per 1,000 for 1,00,000 population and above.
(*Page* 19, *Para* 2.13.4)

25. Hospitals of 25 beds should be ultimately capable of being expanded to 50 beds and the one for 50 beds should be capable of being expanded to 100 beds. (*Page* 19, *Para* 2.13.5)

26. If different townships are closely located, the possibility of sharing a bigger hospital can be looked into, as that will enable the authorities to provide for better medical facilities at lesser cost. (*Page* 20, *Para* 2.13.8)

27. A health centre may be provided for a population of 20,000. A built up area of 5,000 sq. ft. and land area of, 1.0 to 1.5 acres should be adequate for such a health centre. (*Page* 20, *Para* 2.13.9)

28. In planning health facilities for a township, the services that would be rendered by the Employees State Insurance Corporation should be properly coordinated. (*Page* 20, *Para* 2.13.9)

29. Adequate shopping facilities should be provided in the township at the rate of six shops per thousand of population. These should be suitably distributed among the neighbourhoods, sectors and the town centre. (*Page* 20, *Para* 2.14.1)

30. A community centre should be provided for a population of 20,000. An area of 3.0 to 4.0 acres should be adequate for this. (*Page* 21, *Para* 2.15.1)

31. A club may be provided for 20,000 to 30,000 of population and an area of 1½ to 2 acres for such a club is reasonable. (*Page* 21, *Para* 2.15.2)

32. Land at the rate of 0.75 to 1.00 acre per thousand of population should be reserved for the town centre. (*Page* 22, *Para* 2.16.3)

33. The structure of land use at the sector level should be as given in the table below: (*Page* 23, *Para* 2.18.1)

	Uses	Percentage of Developable area
1.	Residential plots	45—50
2.	Roads and streets	15—20
3.	Schools (including their playgrounds)	12—15
4.	Parks and open spaces	8—10
5.	Shopping	2—4
6.	Other uses	Balance
	TOTAL	100

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34. While fixing the source of water supply, care should be taken to see that it is capable of being developed in stages to meet the ultimate demand of the main industry, ancillary industries and the township. (*Page* 24, *Para* 3.2.1)

35. Water supply installation should be designed to give 40—50 gallons per head per day. (*Page* 24, *Para* 3.2.2)

36. A single system of water supply for domestic consumption, fire fighting and arboriculture should be adopted. (*Page* 25, *Para* 3.2.4)

37. The water supply distribution system should be designed for 1½ to 2 times the average demand with a continuous supply.
(*Page* 25, *Para* 3.2.7)

38. Where water supply distribution pipes are not subjected to heavy pressures, it is wasteful to specify B class, C.I. pipes. Steps should be taken to manufacture a lower class of C.I. Pipes.
(*Page* 26, *Para* 3.2.8)

39. Where land is available the secondary treatment of sewage could be through sewage farming or waste stabilization ponds.
(*Page* 27, *Para* 3.4.2)

40. Storm water drainage should be normally designed for half to one inch of rainfall per hour. (*Page* 27, *Para* 3.5.1)

41. Single row of lighting for sector roads and double row for main roads will be satisfactory. The lighting poles may be spaced at 100 ft. intervals. (*Page* 28, *Para* 3.6.2)

42. For electric transmission under-ground cables, though costlier, are better in the long run. (*Page* 28, *Para* 3.7.1)

43. Enclosures should be provided at suitable places for depositing refuse from houses which should be collected in covered lorries and taken to places of disposal. Where land is available, composting could be adopted for conversion of refuse into manure and the same utilised for gardening and agricultural purposes.
(*Page* 28, *Para* 3.8.2)

44. A list of points that deserve consideration in the preparation of the town plan along with norms and standards laid down for each is appended to the report. It will be a good practice if the project authorities fill up the check list while forwarding any project report for sanction, as this will give at a glance the norms for different items and the extent to which these have been realised in a particular case. (*Page* 29, *Para* 3.11.1)

45. The administration of industrial township should vest fully with the industrial authority as is the case with Military Cantonments, where the defence authorities have an effective control. This requires enactment of a suitable legislation. (*Page* 30, *Para* 4.4)

46. Health, education and transport facilities should be subsidised to some extent but water supply and power should be paid for by the workers. (*Page* 31, *Para* 4.5)

47. Suitable higher rent should be recovered from supporting population (land and buildings) to cover the cost of the community facilities enjoyed by them. (*Page* 31, *Para* 4.5)

48. While with regard to essentials, there should be compromise, a phased programme could be followed for providing certain other facilities in the township which may not be utilised to a great extent in the early stages of its development. (*Page* 34, *Para* 5.3.2)

49. In order to prevent the boosting up of requirements of certain types of materials and the consequent enhancement in tender bids, the specifications for construction activities should be diversified.
(*Page* 35, *Para* 5.3.4)

50. In the matter of specifications, more stress should be laid on the technical requirements rather than specifying by a place, a colour or a manufacture. (*Page* 35, *Para* 5.3.4)

51. There is great scope for the adoption of pre-fabrication techniques in the construction of industrial projects. (*Page* 35, *Para* 5.3.5.)

52. The possibility of using by-products for constructional works should be explored. (*Page* 36, *Para* 5.3.6)

53. Consultative councils of contractors and engineers should be held at stipulated intervals with a view to exploring possibilities of cost reduction. (*Page* 37, *Para* 5.4.2)

54. It is advantageous for industrial undertakings to get some of its works executed departmentally. For this purpose, it should build up an adequately staffed and well-equipped nucleus. (*Page* 37, *Para* 5.4.2)

55. Governmental constructional agencies like the National Buildings Construction Corporation and National Projects Construction Corporation and social welfare organisations like the Bharat Sewak Samaj should be given opportunities to tender for works along with professional contractors. (*Page* 37, *Para* 5.4.2)

56. Major industrial undertakings should prepare their schedule of rates and specifications for the different items of works. (*Page* 37, *Para* 5.4.4)

57. The Line of Balance Technique would be of immense help in coordination of works in different sectors of the projects and in securing proper balance in the levels of execution of the different component works. (*Page* 38, *Para* 5.4.6)

58. Some of the recommendations of the Committee on Plan Projects on Public Works Administration could be of use in respect of works administration in projects. (*Page* 38, *Para* 5.4.7)

59. A separate head of account may be kept for the maintenance and administration of township. (*Page* 39, *Para* 5.5.1)

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CHECK LIST

Sl. No.	Factors to be considered	Recommendations and Standards proposed	Figures obtained in the particular case	Reasons for variation, if any
1	2	3	4	5
1.	Regional Master Plan	(i) Regional master plan should be available for whole area. (ii) The location of the industry in question should be related to this master plan.		
2.	**Location** of Township	(i) There should be a buffer area between the factory and the township which may be about 1/3 to 1/2 mile in the case of steel and heavy industry and less for other industries.		
3.	Acquisition of land	(i) Land acquired should take into account the expansion needs for the next two decades. (ii) Acquisition of good agricultural land should be resorted to only when it is absolutely unavoidable.		
4.	Coverage of accommodation ..	(i) The extent of accommodation to be provided for should be decided after taking into account the possibility of utilising the available accommodation into the neighbouring towns and villages. (ii) Provision must also be made for the supporting population.		

CHECK LIST—*contd.*

<table>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td>5.</td><td>Preparation of the Town Master Plan .. ..</td><td>(i) The master plan for the whole town should be prepared before starting work on any particular sector of the town.</td><td></td><td></td></tr>
<tr><td>6.</td><td>Density standards .. ..</td><td><table>
<tr><th>Density</th><th>Dwelling units per acre</th><th>Persons/ acre</th></tr>
<tr><td>Sector Density</td><td>14–20</td><td>65–95</td></tr>
<tr><td>Township Density</td><td>9–12</td><td>45–55</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>7.</td><td>Scales of accommodation ..</td><td><table>
<tr><th>Type</th><th>Cate-gory</th><th>Plinth Area</th><th>Plot area per ground floor unit</th></tr>
<tr><td>I</td><td>F</td><td>365 sft.</td><td>100—150 syds</td></tr>
<tr><td>II</td><td>E</td><td>400 sft.</td><td>150—200 ,,</td></tr>
<tr><td>III</td><td>D</td><td>600 sft.</td><td>200—250 ,,</td></tr>
<tr><td>IV</td><td>C</td><td>900 sft.</td><td>325—400 ,,</td></tr>
<tr><td>V</td><td>B</td><td>1500 sft.</td><td>650—850 ,,</td></tr>
<tr><td>VI</td><td>A</td><td>2100 sft. plus 240 sft. for servants and 225 sft. for garage.</td><td>850—1000 ,, plus 100 syds. for servants and garage.</td></tr>
</table></td><td></td><td></td></tr>
</table>

8. Road and Street standards ..

Type	Right of way	No. of lanes
Arterials with central median	200′ on the periphery of the town otherwise 160′.	One on either side of the central median to start with and two on either side ultimately.
Major roads (Principal traffic routes)	80′ to 100′	Two lanes to start with and four lanes ultimately.
Neighbourhood roads	45′ to 60′	Two lanes.
Residential streets	30′ to 45′	Two lanes.
Culs de sac (not to exceed 600′ in length)	25′ to 30′	Two lanes.
Loops giving access to residences (with open spaces on one side)	10′ to 15′	—
Service lanes to be provided in the case of row housing only	15′ to 20′	—
Cycle tracks	7′ to 9′	—

CHECK LIST—*contd.*

	2	3	4	5
9.	Schools			
	Primary ..	(i) One primary and nursery school of 400—500 seats per 3,500 population (a neighbourhood). (ii) Built up area of school—11,000 sft. (iii) Land area—3 acres.		
	Secondary ..	(i) A secondary school of 650 seats for a population of 9,000-1,0000 (a sector). (ii) The school must be capable of being expanded to thousand seats. (iii) Built up area of the school must be 45 sft. per place. (iv) Land area 6 to 8 acres.		
10.	Academic College	(i) Provision for this may be made only when ultimate population of the town is to be about a lakh and a half. (ii) Land area 15 acres.		
11.	Technical and Vocational School	(i) One or two technical schools may be provided depending upon the size of the town. (ii) Land area 12 to 15 acres.		
12.	Recreational facilities	(i) An allowance at the rate of 3 to 4 acres per thousand of population may be made for parks, open spaces and recreational facilities. (ii) This should be distributed in the neighbourhoods, sectors and in the central area of the town.		
13.	Health facilities	(i) Number of beds in the hospital could be as follows : 30 beds for 10,000 population 75 beds for 25,000 population 125 beds for 50,000 population 2 beds per thousand for one lakh and above.		

		(ii) The total built up area of the hospital per bed will be about 720 sft. for 25 bed hospital, 720 sft. for a 50 bed hospital, 540 sft. for a 100 bed hospital, 400 sft. for a 200 bed hospital. (The standards given above include all sections of the hospital including out-patient department). (iii) There should be one health centre for 20,000 of population. A built up area of 5,000 sft. for a health centre is adequate.
14	Shopping facilities	(i) The total number of shops in the township should be of the order of 6 shops per thousand of population. (ii) These should be suitably distributed in the neighbourhood, sectors and the town centres.
15.	Civil Centre and Clubs	(i) One civic centre should be provided for a population of about 20,000. (ii) Land area for a civic centre should be 3 to 4 acres. (iii) Provision may be made for clubs at the rate of one for 20,000 to 30,000 of population. (iv) Land area for a club may be 1½ to 2 acres.
16.	Town Centre	(i) An area of 0·75 to 1 acre per 1,000 of population may be earmarked for the Town Centre.

CHECK LIST—*contd.*

1	2	3	4	5
17.	Other Town facilities	Provision should be made for Police Station, Post Office, Cemetries, Cremation grounds, religious uses etc.		
18.	Pattern of Land use for a sector	Uses — Percentage of developable area (1) Residential plots .. .. 45—50 (2) Roads and streets .. 15—20 (3) Schools (including their play grounds) .. .. 12—15 (4) Parks & open spaces .. 8—10 (5) Shopping .. .. 2—4 (6) Other uses .. .. Balance		
19.	Water supply	(i) Provision must be made at the rate of 40 to 50 gallons of water per head per day for domestic consumption. (ii) Water supply should be on a continuous basis. (iii) Distribution system should be designed for 1½ to 2 times the average demand.		
20.	Storm water drainage	(i) Storm water drainage system should normally be designed for 1/2 inch to 1 inch of rainfall per hour.		
21.	Street lighting	(i) Single row of lighting for sectors and double row of lighting for main roads should be adopted. (ii) Incandescent lighting is sufficient in all cases except main roads where fluorescent lighting can be used.		

22. **Refuse** collection and disposal	(i) Properly designed enclosures at suitable places in the township must be provided for depositing refuse from houses. (ii) Disposal of refuse can be done either by controlled tipping in low lying areas or through composting. (iii) If composting is resorted to and where facilities for marketing the compost are available, land at 2 acres per 10,000 of population should be set apart in the initial stage of planning.

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APPENDIX I

List of Industries visited and the persons with whom the Panel had discussions

	Industries visited and date	Officers with whom the Panel had discussions
	Mysore State	
1.	Hindustan Machine Tools, Jalahalli. (21-5-1962)	Shri S. M. Patil, General Manager. Shri D. Rajagopalan, Personnel Manager-*cum*-Town Administrator. Shri K. R. S. Gowda, Manager, Civil Engineering.
2.	Indian Telephone Industries, Durvani Nagar. (21-5-1962)	Shri S. K. Kanjilal, Managing Director. Shri N. V. Shenoi, General Manager. Shri Mahabir Sarup, Personnel Manager. Shri K. N. Sunder Ram, Dy. Engineer, Construction Deptt. Shri N. Nanjan, Welfare Officer.
3.	Hindustan Aircraft Ltd., Vimanapuram (22-5-1962)	Lt. Col. Rajan Raju, Chief of Design (Const. & Maintenance). Group Capt. K. C. Sarkar, Chief Administrative Officer. Shri G. Vasudeva Rao, Industrial Relations Manager. Shri S. A. Chaugule, Asstt. Personnel Manager. Shri V. S. Ratnam, Civil Engineer. Shri V. S. Padmanabhan, Executive Engineer (Housing). Shri V. K. Naidu, Plant Design Engineer. Shri K. Sreepal, Electrical Engineer. Shri N. C. Das, Labour Welfare Officer.
	Madras State	
4.	Neyveli Lignite Corporation Neyveli (24-5-1962)	Shri C. A. Narayanaswami Ayyangar, Superintending Engineer (Civil) Township. Shri G. Krishna Murthy, Asstt. Information Officer.
	Bombay State	
5.	Walchand Nagar Industries (13-9-1962)	Shri M. G. Madge, Works Manager. Shri M. N. Gandhi, Civil Engineer. Shri J. A. Gumaste, Farm Manager.
	Bihar State	
6.	Jamshedpur (TISCO) (16-10-1962 & 17-10-62)	Shri R. S. Pande, Agent. Shri Kanth, Director of Town Services. Lt. Col. Dhondy, City Engineer. Shri A. K. Aga, Officer on Special Duty. Shri Basu, Town Development Officer. Shri Jha, Assistant Public Relations Officer.

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	Industries visited and date	Officers with whom the Panel had discussions
7.	Adityapur Township (16-10-62)	Shri S. N. Malik, Special Officer (Development). Shri K. Singh, Executive Engineer.
8.	Jamshedpur (TELCO) (17-10-62)	Shri V. S. Kulkarni, Dy. Chief Engineer (Const.). Col. P. M. Kaka, Town Administrator.
	Orissa State	
9.	Rourkela (H. S. L.) (18-10-62)	Shri S. T. Raja, General Manager. Shri Dass, Senior Dy. General Manager. Shri P. H. Vaidyanathan, Chief Engineer. Dr. B. S. Dhillon, Chief Medical Officer. Shri Banerjee, Dy. Chief Engineer (C).] Shri Ramiengar, Dy. Chief Engineer (G). Shri S. K. Guha, Superintending Engineer (Const.). Shri J. N. Panda, Public Health Engineer. Shri L. N. Barik, Divisional Engineer Designs.
	Bihar State	
10.	Hindustan Steel Ltd. Ranchi (19-10-62)	Shri J. M. Shrinagesh, Chairman. Shri K. N. Subbaraman, Director (Const.). Shri Phiroz Kutar, Director (Production). Shri M. S. Rao, Director (Personnel). Shri Indarjit Singh, Director (Finance).
11.	Heavy Engineering Corporation. Ranchi (19-10-62)	Dr. A. Nagaraj Rao, Chairman. Maj. Gen. E. Habibullah, Director, R.L.W.T. Shri H. V. Narayan Rao, Director (Const.). Shri Sandilya, Director [(Finance). Shri M. M. Bose, Chief Engineer (Civil). Shri G. B. Wadhwani, Superintending Engineer, Public Health (Township). Shri P. R. Rao, Superintending Engineer Township. Shri J. B. Dube, Architect & Town Planner. Shri D. A. Nair, Public Health Engineer.
12.	Bokaro Steel Plant (21-10-62)	Shri L. Ramachandra Rao, Dy. Chief Engineer. Shri B. Kambo, Architect and Town Planner, H. S. L.

APPENDIX II

No. 1068/SF/60

GOVERNMENT OF INDIA
MINISTRY OF FINANCE
(DEPARTMENT OF EXPENDITURE)

New Delhi, the 23rd March, '60.

OFFICE MEMORANDUM

Sub-:—Industrial Housing in the Public Sector

The question of policy regarding the houses to be provided for various projects in the public sector has been considered in the Committee of Economic Secretaries and certain broad principles have been decided upon in the interest of economy. The reduction in cost can principally be secured by ensuring that the standards of accommodation while adequate, are kept down as far as possible. Apart from the capital investment in housing, the projects would also have to incur recurring cost to the extent that the rents charged are lower than the reasonable return from the capital invested in housing. This difference between the rent charged and the reasonable return from such capital investment is in the nature of a concealed subsidy which should be kept as low as possible.

2. The following conclusions have been arrived at in respect of the scales of accommodation, the extent of coverage, that is, the number of houses *vis-a-vis* number of employees, the investment of private capital in housing and other related matters.

I. There should not be more than six types of quarters that may be constructed corresponding to the various pay ranges :—

Type	I	for salaries below Rs. 60 p. m. plinth area 365 sft.
Type	II	upto Rs. 150 p. m. plinth area 400 sft.
Type	III	for salaries from Rs. 151—300 p. m. plinth area 600 sft.
Type	IV	for salaries Rs. 301—750 p. m. plinth area 900 sft.
Type	V	for salaries from Rs. 751—1500 p. m. plinth area 1500 sft.
Type	VI	for salaries above Rs. 1500 p. m. plinth area 2100 sft. plus 240 sft. for servants plus 225 sft. for garage.

Having regard to the cost of construction on the basis of the 6 per cent of return on the cost of construction, land and development and on the assumption that rent fixed would be subject to a ceiling of not more than 10 per cent of the emoluments, the concealed subsidy in the form of difference between 6 per cent return and the rent at 10 per cent of pay should work out approximately to Rs. 1500 per month for 100 assorted houses, in the proportion of say, 80 per cent for types I-III, 13.5 per cent for type IV, 6 per cent for type V and 5 per cent for type VI. It may be necessary to vary the percentage of various types to suit the requirements of individual projects, but the specifications, scales of accommodation, etc.

should be so adjusted that;

(a) the amount of such subsidy for the said 100 houses of mixed types should, as far as possible, not exceed Rs. 1500 per month, and

(b) the accommodation of persons drawing over Rs. 300 per month should not normally be subsidised.

II. It is not possible to lay down the extent to which houses should be provided for the employees by way of a percentage of the total number of employees since this will vary from project to project and the decision on the point would largely depend on the overall local conditions and the requirements of housing in the project from time to time. In this connection, the Buildings Projects Team of the Committee on Plan Projects has also been asked to explore the possibility of having small blocks of houses in the satellite villages as the pattern of rural housing would not be an exact replica of industrial houses near the factories and their total cost will be comparatively low.

III. It may also be possible that a sector of the residential colony could be sold out in plots to private individuals for building houses, particularly near the market area. However, it would be necessary to ensure that the development of this sector is subject to Town Planning Regulations. Projects may also consider whether some of the houses built by them could be sold to their employees on the hire-purchase system and a sector of the Housing Colony could be set apart for such sales to workers.

3. The above conclusions would apply to all projects in the public sector under the direct administrative control of the various Ministries. In regard to corporations, companies and other autonomous bodies managing projects, it is requested that a copy of this letter may be passed on to them as well.

4. All Ministries, in particular, the Ministries of Works, Housing and Supply, Defence, Railways, Posts & Telegraphs and others who have to arrange construction for Government employees are requested to review their existing criteria and standards of the scales of accommodation and specifications in the light of the above conclusions. It is expected that considerable economy can result in respect of expenditure on housing if the above conclusions are borne in mind. The result of the review of their existing standards and the new standards that they may propose to adopt may kindly be communicated to the Ministry of Finance, as soon as the review has been carried out.

(Sd) N. N. WANCHOO
Secretary to the Govt. of India.

To

All Ministries of the Government of India,

No. 2934-W/60. *New Delhi, the 23rd March, 1960.*

Copy forwarded to all Heads of Divisions.

(Sd) GURDEV SARAN
Under Secretary to the Govt. of India.

Shri Indarjit Singh, J.S. (Economy), Ministry of Finance.

No. EL (II)-PC/60

GOVERNMENT OF INDIA

MINISTRY OF FINANCE

(DEPARTMENT OF EXPENDITURE)

New Delhi-2, the 4th Aug., 1960.

OFFICE MEMORANDUM

Sub :—Industrial Housing in the Public Sector

Reference this Ministry's Office Memorandum No. 1068-SF/60 dated the 23rd March 1960 on the subject indicated above. The following amplifications may be made of the instruction issued therein :—

(i) In calculating the economic rent it has been stipulated that the cost of land and development should also be added to the cost of houses. For this purpose an addition of 10 per cent to the cost of respective houses may be allowed and every effort made to keep the cost within this limit. If, however, this is not possible in any case the detailed reasons for the same should be brought to the notice of the sanctioning authority.

(ii) For houses to be constructed in areas where the cost of construction is higher than in Delhi the standard subsidy of Rs. 1500 for 100 assorted houses might be increased by 15 per cent for every increase of 5 per cent in the construction cost index (compared to Delhi), limited to a maximum of 75 per cent.

2. The amplifications in paragraph 1 above may also be brought to the notice of the Companies, Corporations and other autonomous bodies who may be requested to fall in line with these instructions.

Sd. (N. N. WANCHOO)
Secretary to the Govt. of India.

To

All Ministries of the Government of India.

APPENDIX III

Space requirements of hospitals of varying bed strengths

AREA SCHEDULE IN SFT.

	200 beds	150 beds	100 beds	50 beds	25 beds
Administration	3200	3000	2400	1900	1150
Outpatient Department ..	9000	8600	6700	5050	2700
Diagnostic Unit	3000	2900	2100	1650	1000
Therapeutic Unit	6000	6000	3500	3000	1600
Services	3650	3450	2700	2500	1100
Maternity & Gynaecology ..	7400	6550	5000	4050	1900
Nursing Units (Wards) including internal circulation	25000	20000	13300	6400	3350
Total Carpet Area & Sanitary Accommodation	57250	50500	35700	24550	12800
Add for Circulation & Wall at 30% to 40%	22750	21500	18300	11450	5200
Total Built-up Area	80000	72000	54000	36000	18000
Built-up area per bed ..	400	480	540	720	720

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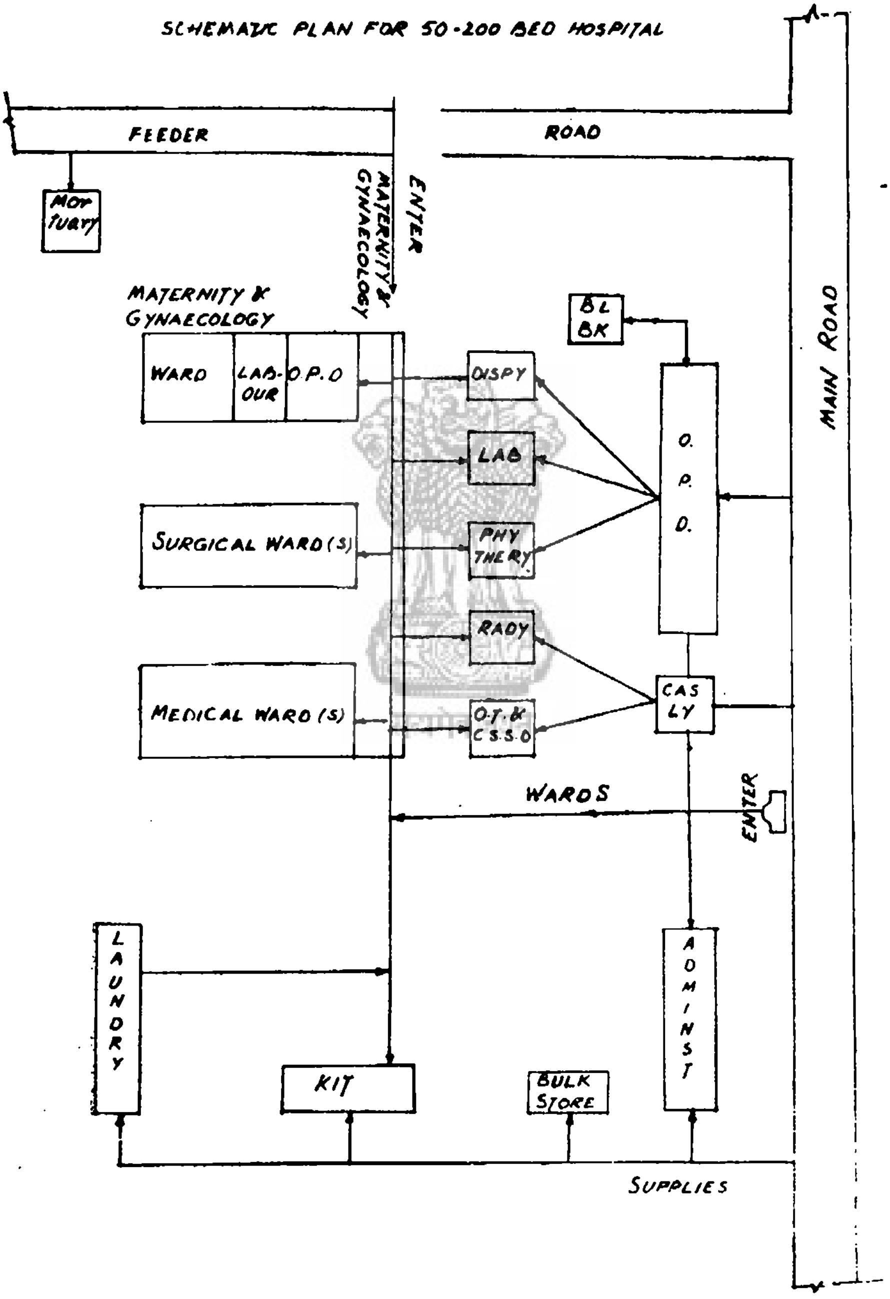
APPENDIX IV

SCHEMATIC PLAN FOR 50-200 BED HOSPITAL



APPENDIX V

Waste Stabilization Ponds (Oxidation Ponds)

Once known 'Sewage Lagoons' or now called "Waste Stabilization Ponds" are getting more and more popular in the U.S.A., Australia, Canada and Sweden as the accepted sole process of sewage treatment specially for small sewage works. The most significant factor responsible for their growing popularity appears to be their apparent low construction and maintenance cost.

From a few observations made on a pilot oxidation pond by C.P.H.E.R.I. at Nagpur, it appears that this method of treatment has a great potential in our country for treating sewage from large communities also.

A Waste Stabilization Pond is similar to the other conventional aerobic processes in use for the treatment of sewage.. It differs from them in the method of providing oxygen; whereas, the other processes obtain their oxygen from the atmosphere, either through surface or diffused aeration, the waste stabilization pond relies upon the natural phenomenon of photosynthesis to furnish the required oxygen. The necessary major ingredients for photosynthesis include algae, light water and carbon. By the action of light upon the chloroplastic tissues of the algae, oxygen is derived from the decomposition of water. Both the algae and bacteria are mutually beneficial to each other; the algae providing oxygen for the bacteria and the bacteria providing carbon and other nutrients for the algae.

The success of this symbiosis in effecting purification of sewage is dependent upon many variables such as light intensity, light periodicity, temperature, detention period, organic load and so forth.

A good deal of research work has been done abroad on the relationship of these variables and on the development of more exact and rational approaches for proper design. More work is necessary in our country where conditions are more favourable for the successful performance of waste stabilization ponds.

In siting the waste stabilization ponds preliminary study of geology and hydrology of the area is necessary. This is very important because, these factors are directly related to the possible pollution of underground water sources. Generally, the contamination of underground water by chemicals is more of a problem than that by bacteria. The other factors which affect the degree of underground water contamination include the distance of the pond above the water table, the direction of ground water flow which may not be the same as the slopes of the land surface and the nature and permeability of underground formations.

Where detailed geologic and hydrologic investigations are not possible, attention must be paid to (1) use of an impervious material for pond bottom, (2) remote location, (3) utilization of prevailing topography to best advantage and (4) seepage tests and core borings requirements.

In addition to the geologic and hydrologic factors, other factors requiring consideration in the site selection are—proximity to habitation, wind conditions, cost of land, adequacy for expansion and the character and nature of the receiving units.

Wind conditions must be favourable for maximum mixing and agitation of the pond contents. Preference should be given to sites that permit unobstructed wind action on the water surface.

Climatic factors such as solar radiation, temperature, precipitation, evaporation and wind have also to be taken into account.

The penetration of incident light determines how much of the pond volume will participate in oxygen production. Solar radiation will vary with latitude elevation and could cover.

Experiments have shown that algae cells absorb light within close limits, in accordance with Beer-Lambart Law. It has been revealed that algae concentration in normal sewage affects the depth of light penetration and accordingly the optimum depth of pond.

In the Dakotas studies performed by (U.S.P.H.S.) United States Public Health Service the depth of measured light intensity varied from 2" to 27½". During winter months ice formation reduced the amount of light reaching the liquid to the point where photo-synthesis was nil resulting in anaerobic conditions under continued ice cover.

Oxygen production at the light intensities prevailing at various depths was also measured in the Dakotas studies. It was found that the rate of oxygen production from photosynthesis dropped off rapidly with depths similar to the decrease in light penetration. Great variation in dissolved oxygen throughout the day was also observed. Day time peaks ranged from near saturation to several times this value. Normally, during the night, the concentration of dissolved oxygen decreased to less than saturation. However, during some night periods, following unfavourable day time conditions, the dissolved oxygen dropped down to zero and remained there for one to several hours.

Normally, pond temperatures closely follow the air temperatures with the degree of fluctuation decreasing as pond depth increases.

It is noticed at other installations in the U.S.A. that high pond temperature favour the production of blue-green algae, which in turn may produce objectionable odours.

It has also been found that on calm days, sharp vertical gradients in temperature, dissolved oxygen and algae distribution are prevalent even in relatively shallow ponds.

It has also been noticed that with detention periods of three to four days and optimum temperature and light, almost all the available ammonia nitrogen reacts with other compounds to form algae cell material.

It has been observed that a waste containing 30 parts per million of nitrogen will support 300 parts per million of algae cell before the nitrogen becomes a limiting factor of cell growth.

Since substrates vary in nutrient content, further research is needed to determine whether a given domestic sewage will support enough algae growth to meet its oxygen requirements for photosynthesis.

B.O.D. removals in Dakota ponds ranged from a low of 43.4 per cent under ice to a maximum of 98.4 per cent in open water. Coliform removal was also of a high order.

Organic loading can be as high as 300 lbs. per acre per day. High rate loaded plants developed dense enough algae growth to supply nearly all oxygen requirements.

Excellent B.O.D. removals can be obtained by operating two ponds in series, the first anaerobic and the other aerobic.

Uses

Ponds can be used to serve a variety of purpose in the treatment of waste waters :

(1) For the complete treatment of sewage within the pond cells.

(2) For tertiary treatment following trickling filters and final setting tanks.

(3) For treating wastes from oil refineries, slaughter houses, dairy product plants, poultry handling processes and rendering plants.

(4) For fish culture—karf thrives in such ponds as do some game fish including rainbow trout, black bass, pike, perch and tench. To raise these fish, B.O.D. loading must be carefully regulated so that the fish are not endangered by deletion of dissolved oxygen. Gambusia affinis, the top minnow used to control mosquitoes, has been the chief fish grown in the stabilization ponds in the United States.

(5) For algae for animal food—Oswald and Golmeka have tried several methods to find an economical means of removing and drying algae for animal food supplement from ponds at Concord (California). Methods used were centrifugation and alum flocculation followed by spray or drum drying or drying the algae on sand beds.

Mosquitoes and other vectors

Some concern was raised in the U.S.A. regarding the Public health hazard from the standpoint of mosquito breeding. Considerable research work was done there in this matter and it was found out that wherever mosquitoes were experienced this was due to vegetation being present in the ponds.

The intensity of mosquito production in the ponds surveyed varied directly with the amount of weed growth. Those shallow ponds that have contained abundant emergent vegetation invariably produce tremendous numbers. Othér ponds where such vegetation is marginal may produce large numbers along the peripheral area. Conversely, ponds free from vegetation did not present any mosquito problem.

The weedy condition may be related to several factors, one of the most important being faulty filling of the pond.

It has been observed in a number of instances that filling difficulties and the concomitant shallow weedy conditions are related to the porous nature of the soil and the lack of attention to sealing of the pond. It also has been observed that many weedy situations are due to over-design.

It has been noticed that weed problems in the ponds were minimised in some instances because the ponds were filled with water immediately after construction. Where sewage flows were made to fill the pond, the time required to fill the ponds being much longer, the weed growth became a problem.

Another problem related to weed control and to the proper management of the pond was the lack of outlet structures that permitted complete water level control.

Inadequate pond maintenance—such as lack of care by the operator, is a frequent cause of weed problem in the pond proper or on the banks.

The following suggestions are made for either preventing or correcting mosquito problem :

(1) Proper size of the pond should be determined carefully. It should not be too large for the population served. Provision for multiple ponds is an excellent means of allowing for expansion.

(2) The pond should be constructed so as to hold water. Artificial sealing with chemicals, clay, bentonite or plastic or asphalt membranes should be used if necessary.

(3) Complete water level control and drainage structures should be built into the pond. Such structures facilitate the control of marginal vegetation by the use of water level management (draw-down) coupled with soil sterilants. Lowering the water level temporarily also may be used to control mosquito larvae.

(4) The dikes should be of sufficient width (generally 8 ft.) to permit access of maintenance machinery such as seeddrills mowers and larviciding or herbiciding equipment.

(5) The inner slopes of the embankment should be relatively steep, *i.e.* 3 to 4 feet horizontal to 1 vertical.

(6) The depth should be as great as possible for maximum waste treatment. Depths over 25″ will discourage the development of Cattoil and other emergent plants. Ponds should be kept at a minimum depth of 4 feet during the mosquito breeding season.

(7) The pond bottom should be cleared of vegetation prior to filling and it should be as level as possible.

(8) The embankment of the pond should be planted with a suitable species of grass such as brome. Care should be taken, however, to avoid species such as reed canary grass, which may invade water. Fertilization of the dikes will aid in the development of grasses.

It will be obvious that public health hazards can be minimal if ponds are designed, constructed and managed properly.

As these ponds have great potentialities due to favourable climatic conditions, more research on the right lines must be started all over the country without any delay.

The effluent from the stabilization ponds can be used for irrigation or for rearing fish (fish-ponds).

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APPENDIX VI

"Application of Line of Balance Technology"

The pamphlet captioned "Planning and Programming of Works—Application of L.O.B." published by the COPP deals in full length with the technology and the multifarious applications of the technique.

A brief resumé is given for ready reference.

The L.O.B. study comprises the following 4 steps listed in the sequence in which each is developed.

(1) **The objective.**

(2) The programme-production of construction plan.

(3) Programme progress which indicates the status of performance at a particular point of time.

(4) The line of balance which gives a visual comparison of the progress with the objective in view.

The objective is normally set out by the authorities responsible for sponsoring the project. For example, in the construction project exhibited in the *Annexure* the objective is that 50 residential units should be constructed within a period of 32 months, at the rate of 15 units in 16 months, 25 units in 24 months and 50 units in 32 months according to the sponsoring agency.

The next step is programming which is the key part of the process. The programme should cover all the key items from the initiation of the work to its completion. The criterion for selecting the. "Key items or controlled points" is not so much with financial implication but they have a limiting and halting influence on the programme as a whole. We may cite the example of sewage pumps or bearings for bridges, the cost of which may not be significant compared to the cost of the whole programme. After selecting such points the lead time for each has to be calculated in a realistic way. Allied to the lead time is the "time coverage" for each constituent.

The *Annexure* shows that the time coverage for cement is more than that of steel even though the lead time is the same. This is dictated by the construction process and helps in budgeting for material and ordering out the supplies according to a phased programme.

The terms "Lead Time" and "Time Coverage" may be explained as follows : The point of initiation of a task reckoned from the point of completion of the work is called the "Lead time" of a particular task. Again an internal time relationship is established between all the tasks in the programme. This indicates the point of initiation as well as the point of completion of the task, all in terms of time. The duration between the points of commencement and completion in respect of any task is known as "Time Coverage" of the particular task.

The third step in the study is the depiction of progress in the progress chart for the same number of tasks, otherwise called control point or constitutents of the programme. The vertical bars which are constructed to indicate the levels of performance on each task are known as the status bars. The status bars are constructed depicting the physical progress on each task either from personal knowledge or from information gathered from the field through progress reports.

The next step is the drawing up of the L.O.B. which will indicate at any given point of time, the predetermined levels of activity at each control point.

The methodology of constructing the L.O.B. is illustrated with an example given below :—

A construction work is in progress from 1st, January 1961. The objective is to complete 40 units by 31st, December 1961, i.e. in a period of 12 months. The programme has been framed in the manner as explained above. This consists of four constituent elements namely, supply of cement, steel, construction and finishing, including electrical and sanitary installations. The end item is the finished product which is also affixed with a number. The contract schedule has been depicted in the objective chart.

Presume that the executive inspects the work on 31st August, 1961. Precisely it should be possible for him to know the progress that should be obtaining on the four constituents and what actually obtains on that day. The former is given by the L.O.B. and the latter by the status bars constructed with feed back information.

The study date is 31st, August, 1961. To know the progress that should be obtaining on task No. 1 set off four months *i.e.* the lead time of task No. 1 from the study date to the right on the horizontal axis of the objective chart. Then draw a vertical line to meet the contract schedule. From the point of intersection draw a horizontal line to cross the bar relating to task No. 1 and this gives the predetermined level of an activity on the particular day of the particular task. Similarly to know the progress that should obtain on task No. 2 set off three and a half months to the right from the study date on the horizontal, and then draw a vertical line to meet the contract schedule and draw a horizontal line from the point of intersection to cross the bar relating to task No. 2. Repeat the progress for every task. The horizontal bars thus obtained may be connected with vertical lines to form a staircase pattern of line, which is the line of balance.

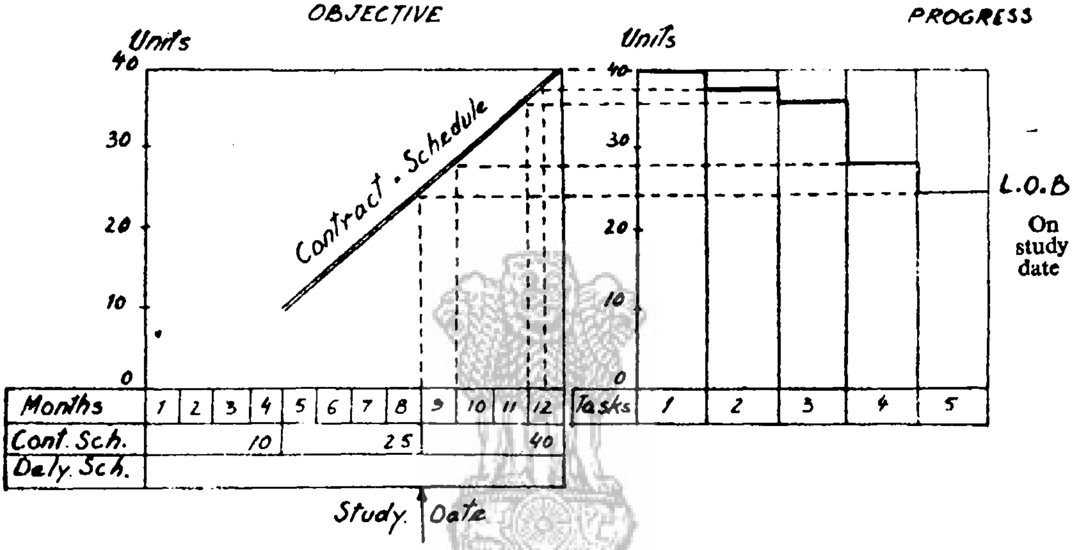
The line of balance can be drawn even before the commencement of the construction activity for desired intervals of time. The line of balance at any time will show the level of activity that should have been attained at all the controlled points in order to be "in phase" with the target. When the actual progress of various items is measured against this line of balance, it will be easy to see whether the whole project is going in tune with the target or not. If the progress is above the line of level, it will indicate expenditure ahead with utility. In such cases the authority concerned can take a conscious view whether such expenditure should be committed or restricted and the money diverted elsewhere for more profitable use. On the other hand, if the progress is below the line it should be easily inferred that the project is not going in phase with the target. Certain remedial measures will be necessary and those will be taken in time.

The main advantages of this method of programming and progressing are :(1) It enables the planner to think clearly of all controlling points in the programme and of the lead time and the time coverage for each; (2) the lead time and time coverage have to be based on judgment taking into account the prevailing situation. If certain anticipations do not come true, then the planner can give a reasoned argument for short falls if any in the programme; (3) it gives a visual idea of the position of the projects as a whole at any point of view. This enables remedial measures to be taken in time avoiding thereby spreading of expenditure on a number of items which will not be completed or commit expenditure of certain items ahead of utility; (4) it helps in the recasting of projects if certain expectations do not come true. Such recasting can be done in a more realistic manner by the use of this technique; (5) another advantage is that it enables different levels of administration to view the project on a common basis. The basis of construction is the same but the point of consideration may be different to suit different responsibility. A well co-ordinated view therefore, is possible; (6) the analytical approach engendered by this technique facilitates working out of staff requirements; (7) it helps envisage the limitations of the programme for achieving the desired objective and to concentrate on them from the very beginning; alternatively it enables changes to be introduced in the method of work or organisation if they happen to be limiting factors in the attainment of targets.

Another practical application of this technique highlighted certain other advantages that can accrue from a programme chart. In the absence of a programme chart, one is apt to be confounded by the maze of figures, target dates and delivery schedules and may very well concentrate on items which may not have a halting influence on the programme and leave out others which may have a vital bearing on the successful completion of the project. This was actually what was happening in a manufacturing project which the Committee on Plan Projects had an occasion to study recently. The authorities were unduly worried about the placing of indents for raw materials so that the factory may commence production by the middle of 1963, but when the programme was chalked out on a time scale, the different elements being linked in proper sequence, it was clear that the indenting of raw materials could even be done in April 1962 without affecting the date set up for the commencement of manufacture. It was the civil construction programme which had a vital influence on the successful completion of the project as any delay there would lead to delay in erection of machinery and postponement of production. The emphasis was, therefore, given on the wrong place, which however, could not be helped in the absence of a visual appreciation of the programme. The programming method suggested in the "Line of Balance Technique" atonce gives a pictorial representation of the programme in the background of time which enables quicker apprehension of the halting influences.

The Line of Balance Technique, therefore, is a very handy tool in the hands of those who are in charge of planning, programming and controlling of projects. A knowledge of this method, it is hoped would go a long way in reducing the ever widening gulf between the financial commitment and the realisation of physical assets.

EXAMPLE FOR CONSTRUCTION OF LINE OF BALANCE



Months	1	2	3	4	5	6	7	8	9	10	11	12
Cont. Sch.				10				25				40
Dely. Sch.												

Tasks	1	2	3	4	5

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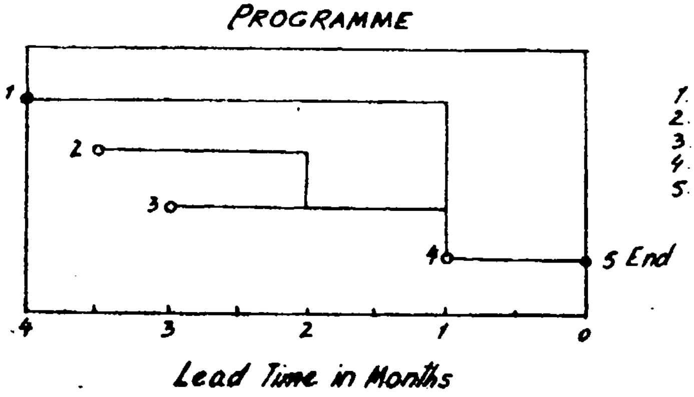

LEGEND FOR TASKS IN PROGRAMME

1. CEMENT
2. STEEL
3. CONSTRUCTION
4. FINISH
5. END

Major Recommendations of the Report on Public Works Administration.

1. More time should be given to engineering departments to plan the works properly with a view to getting the most economical results.

2. Budget provision should be made only for those works which have been administratively approved and demands for funds should only be made after consultation with the Chief Engineer.

3. With a view to more evenly distribution throughout the year, we would suggest that the budget year commences from 1st of July.

4. Budgeting for materials is as important as budgeting for works. We recommend the setting up of material budgeting cells in the State and Central Engineering Organisations and that work of these cells should be coordinated by a Central Cell in the Planning Commission which should be in a position to assess the overall requirements and take steps to ensure that there is no shortfall in the supply of requirements and equipment required in the plan programmes.

5. Requirements of projects should be studied by a composite panel in which all the technological disciplines connected with the particular undertaking including work study are represented.

6. When once requirements have been arrived at in a logical way, the user should normally refrain from making changes at a later stage.

7. Check-lists for different types of projects should be prepared indicating the norms and standards. The engineering departments may use check-lists prepared by the Committee on Plan Projects for multi-storeyed buildings, residential buildings, industrial estates, hostels etc. In other cases, they can prepare check-lists in consultation with the authorities concerned. If schemes are accompained by check-lists indicating the figures sought to be realised in comparison with the norms laid down, it would facilitate checking and avoid to a great extent queries and resultant delays.

8. Social organisations, such as the Bharat Sewak Samaj should be given greater encouragement. They may be given exemptions from payment of earnest money and security deposit. Public Works Departments may also hire out initially their tools and equipment to the Samaj.

9. The earnest money to be paid at the time of tendering should be reduced to 1 per cent of the cost of works subject to a maximum of Rs. 20,000.

10. The security deposit should be released in three stages; 50 per cent on completion of work, 25 per cent on payment of final bill and 25 per cent on the completion of defects liability period. This will avoid to a great extent stagnation of contractors' money.

11. The adoption of lump sum contract would lead to speedier completion of works and reduction in contractual problems.

12. Some conditions of contract are oppressive on one side. Recommendations have been given to modify these conditions with a view to making them equitable.

13. The necessity of prompt payment to contractors does not require special emphasis. The undisputed portion of the bill should be paid within four months of the completion of the work.

14. Engineering authorities should be empowered to accept, where necessary, tenders which are not the lowest subject to an intimation to the next higher engineering authority.

15. If the plan projects are to have an impact on the public, it is essential to see that the flow of benefits is commensurate with the expenditure incurred. This can be achieved by adopting the "Line of Balance Technique". outlined by the Committee on Plan Projects for programming and progressing of works.

16. Existing procedure for stores accounting is cumbersome. A completely revised scheme has been given which would make stores management simpler and more purposeful.

17. Engineering organisations in the country should become more alive to work study and the role it can play in improving efficiency and economy all round and specially in the scheme of cost reduction which has assumed importance today. A Work Study Wing should be set up in each department for evaluation of works and works procedures with a view to economy and efficiency.

18. Powers of engineering officers vary widely and are inadequate to meet the increasing tempo of works. Suggestions for radically altering the powers have been made. Notable among them are mentioned below :

(a) Superintending Engineer should have powers to technical sanction upto 5 lakhs and the Executive Engineer upto one lakh.

(b) The Superintending Engineer should have powers to accept tenders upto 10 lakhs and Executive Engineer upto one lakh.

(c) The Superintending Engineer and Executive Engineer should have full powers to sanction extra items or substituted items for their own contracts.

(d) The Superintending Engineer should have full powers to grant extension of time.

19. Work loads of divisions on value basis have been prescribed taking into account the difference in the nature and type of work :—

Original works (Buildings & Roads)	concentrated	Rs. 40 to 50 lakhs
Original works scattered		Rs. 25 to 40 lakhs
Minor and Maintenance works—		
(Buildings & Roads)	Concentrated	Rs. 16 to 20 lakhs
—do—	Scattered	Rs. 10 to 16 lakhs
Original works (Electrical)		Rs. 20 to 30 lakhs
Maintenance works (Electrical)		Rs. 7 to 10 lakhs

Staffing norms also have been prescribed. With the norms so prescribed, the Chief Engineer should be empowered to create extra divisions or sub-divisions as the volume of work warrants and to staff them.

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APPENDIX VIII

Statement of Township Expenditure and Income

Current Year

Total previous year	Particulars	Salaries and Wages	Stores and Spares	Repair and Maintenance	Power	Water	Printing and Stationery	Postage Telegrams Telephones	T. A. etc.	Total
1	2	3	4	5	6	7	8	9	10	11
	I. Expenditure									
	(1) Estate Office									
	(2) Land Office									
	(3) Horticulture									
	(4) Dairy Farm									
	(5) Medical (Township)									
	(6) Anti-Malaria and Public Health (Township)									
	(7) Education									
	(8) Social Welfare									
	(9) Guest Houses									
	(10) Garage									
	(11) Electrical Division									
	(12) Sewerage									
	(13) Water Supply									
	(14) Cinemas and Theatres									
	(15) Street Lighting									
	(16) Civil Maint. (Buldgs., Bridges Roads and Culverts)									
	(17) Miscellaneous									

(18) Depreciation of Township Asset/Capital Items

1. Land Survey & Development Expenditure
2. Fees to Architect
3. Buildings :
   - (a) Residential
   - (b) Non-residential
4. Roads, Bridges and Culverts
5. Water supply installations
6. Electric Installation
7. Temporary and Enabling Works
8. Tools and Plants
9. Vehicles
10. Miscellaneous Assets
11. Interest.

Total Expenditure

APPENDIX VIII—contd.

1	2	3	4	5	6	7	8	9	10	11
II. Income										
1. **Rent** :										
(a) Residential Bldgs.										
(b) Shops and Plots.										
2. Electricity										
3. Water										
4. Conservancy										
5. Vehicle Hire Charges										
6. Hospital Receipts										
7. Education Fees										
8. Cinema, Theatre										
9. Misc. Receipts										
Total Income										
III. Net Defficit/Surplus %allocable to operation										
IV. Net Allocable to Operation										

PRO-FORMA BALANCE SHEET

Previous Year			*Current Year*	*Previous Year*			*Current Year*
	(1) **LIABILITIES**				**ASSETS**		
	Share Capital	AAA			Fixed Assets		PPP
	Share Deposit	BBB			Less depreciation		
	Secured Loan	CCC			....	QQQ	
	Unsecured Loan	DDD			....	RRR	
					....	SSS	
					....	TTT	
	TOTAL :	EEE	EEE		TOTAL :	UUU	UUU
					(2) **CURRENT ASSETS LOANS AND ADVANCES**		
	(2) **CURRENT LIABILITIES AND PROVISIONS**				Stores, Spares, Raw Materials, Tools etc.	KKK	
	Creditors	FFF			Stock-in-trade	LLL	
	Sundry Liabilities	GGG			Sundry Debitors	MMM	
	Security Deposits	HHH			TOTAL :	NNN	NNN
	Sundry Provisions	I I I			(3) **ADVANCES FOR PLANT AND MACHINERY**		
	TOTAL :	J J J	J J J		Deposits	OOO	
					Other advances	WWW	
					Cash & Bank Balances	ZZZ	
					Security Deposits	I I I	
					TOTAL :	PPP	PPP
					(4) **MISC. EXPENDITURES :**		
					Deferred Revenue	sss	
					Profit & Loss Account (Balance)	ttt	
					TOTAL :	aaa	aaa
	TOTAL :		XXXXX		TOTAL :		XXX

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